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May 15, 1988

Energy Research Abstracts

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UNITED STATES DEPARTMENT OF ENERGY

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ENERGY RESEARCH ABSTRACTS

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Energy Research Abstracts (ERA) provides abstracting and indexing coverage of all scientific and technical reports, journal articles, conference papers and proceedings, books, patents, theses, and monographs originated by the U. S. Department of Energy, its laboratories, energy centers and contractors. *ERA* also covers other energy information prepared *in report form* by federal and state government organizations, foreign governments, and domestic and foreign universities and research organizations. **The user should remain aware that *ERA* coverage of non-report literature is limited to that generated by Department of Energy activity.**

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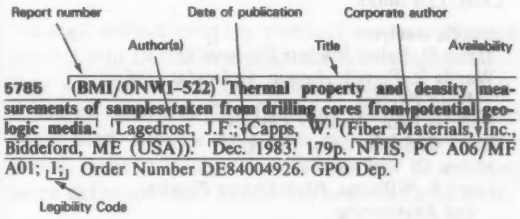
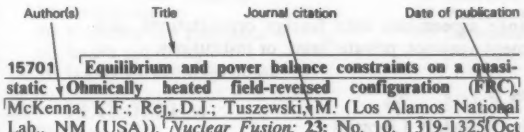
The principal elements of abstract entries for a typical research and development report and a typical technical journal article are illustrated below.



5785 (BMI/ONWI-522) Thermal property and density measurements of samples taken from drilling cores from potential geologic media. Lagedrost, J.F.; Capps, W. (Fiber Materials, Inc., Biddeford, ME (USA)). Dec. 1983. 179p. NTIS, PC A06/MF A01; 1; Order Number DE84004926. GPO Dep.

Density, steady-state conductivity, enthalpy, specific heat, heat capacity, thermal diffusivity and linear thermal expansion were measured on 59 materials from core drill samples of several geologic media, including rock salt, basalt, and other associated rocks from 7 potential sites for nuclear waste isolation. The measurements were conducted from or near to room temperature up to 500°C, or to lower temperatures if limited by specimen cracking or fracturing. Ample documentation establishes the reliability of the property measurement methods and the accuracy of the results.



15701 Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC). McKenna, K.F.; Rej, D.J.; Tuszewski, M. (Los Alamos National Lab., NM (USA)). *Nuclear Fusion;* **23:** No. 10, 1319-1325 (Oct 1983).

Abstract

Zero-dimensional power balance calculations are performed for a quasi-static, purely Ohmically heated field-reversed configuration. Without compression, the constraint imposed by radial pressure balance limits the power input. Estimates of the energy loss from impurity line radiation as well as from classical and anomalous transport are given. Effects of cold puff gas injection are also investigated.

INDEXES TO *ENERGY RESEARCH ABSTRACTS*

Five indexes are provided for approaching the contents of each issue of *Energy Research Abstracts (ERA).* Each index is preceded by an introduction that details the organization of the index and the principles by which it was compiled. The reader is referred to these introductions for information not found in the index examples that follow.

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5785 (BMI/ONWI-522) Thermal property and density measurements of samples taken from drilling cores from potential geologic media. Lagedrost, J.F.; Capps, W. **(Fiber Materials, Inc., Biddeford, ME (USA)).** Dec. 1983. 179p. NTIS Order Number DE84004926. GPO Dep.

is indexed as:

Fiber Materials, Inc., Biddeford, ME (USA)

• Personal Author Index

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

Capps, W., *See* Lagedrost, J. F.
Lagedrost, J.F., Thermal property and density measurements of samples taken from drilling cores from potential geologic media, 9:5785 (R;US)
McKenna, K.F., Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC), 9:15701 (J;US)
Rej, D.J., *See* McKenna, K.F.
Tuszewski, M., *See* McKenna, K.F.

• Subject Index

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

SALT DEPOSITS
Density
Thermal property and density measurements of samples taken from drilling cores from potential geologic media, 9:5785 (R;US)
REVERSED-FIELD PINCH
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Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC), 9:15701 (J;AT)

• Contract Number Index

DOE technical report literature is indexed using contract numbers. This index contains the contract number with corresponding abstract and report numbers.

AC06-76RL01830	**Fiber Materials, Inc., Biddeford, ME (USA)**	
	9:5785	BMI/ONWI-522

• Report Number Index

Technical report literature is also indexed using report numbers. This index includes information on where individual reports may be obtained. Patents and conference papers are indexed here as a matter of convenience. When a report is supplied under an Order Number, that number is included in the availability statement. An Order number–report number correlation is included for convenience.

BMI/ONWI-522	9:5785	NTIS, PC A09/MF A01. Order Number DE84004926, Distribution Category MN-70

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ENERGY RESEARCH ABSTRACTS

01 COAL AND COAL PRODUCTS

REFER ALSO TO CITATION(S) 21947

20747 (CONF-8710261—1) Clean coal technology: An industrial boiler perspective. Wampler, J.A. (USDOE Assistant Secretary for Fossil Energy, Washington, DC). 22 Oct 1987. 10p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88004270/JAW.

From Council of Industrial Boiler meeting; Richmond, VA, USA (22 Oct 1987).

An overview of clean coal technology is presented. Emphasis is placed on the needs for the program's continuation and various benefits of using coal as an energy source. (CBS)

20748 (DOE/PETC/QTR—87/3) [Pittsburgh Energy Technology Center]: Quarterly technical progress report for the period ending June 30, 1987. (USDOE Pittsburgh Energy Technology Center, PA). Feb 1988. 180p. NTIS, PC A09/MF A01; 1; GPO Dep. Order Number DE88006229/JAW.

Research programs on coal and coal liquefaction are presented. Topics discussed are: coal science, combustion, kinetics, surface science; advanced technology projects in liquefaction; two stage liquefaction and direct liquefaction; catalysts of liquefaction; Fischer-Tropsch synthesis and thermodynamics; alternative fuels utilization; coal preparation; biodegradation; advanced combustion technology; flue gas cleanup; environmental coordination, and technology transfer. Individual projects are processed separately for the data base. (CBS)

0103 Preparation

REFER ALSO TO CITATION(S) 20757, 20840

20749 (CANMET—85-2E) Coal preparation washing processes; a technology review. Picard, J.L. (Canada Centre for Mineral and Energy Technology, Ottawa, Ontario). Mar 1985. 87p. Canadian Government Publishing Centre, Ottawa, Ontario.

This project was undertaken to provide information on the various problems associated with the application of conventional coal washing processes in Canada, and to identify areas where further research or new technologies might be applicable. Following a short review of statistics relating to process applications, and an explanation of the methodology for presentation and analysis of the washing data, each of the processes is dealt with individually. Information presented includes: plant data, feed characteristics, and washing results with discussion of the effects of feed or other variables on performance and separation losses. Results indicated a major area of concern was deficiencies found in various aspects of the technology, particularly in the fine coal processes. 30 refs., 43 figs., 48 tabs.

20750 (DOE/PC/91801—T1) Coal conversion and biomass conversion: Volume 1: Final report on USAID [Agency for International Development]/GOI [Government of India] Alternate Energy Resources and Development Program. Kulkarni, A.; Saluja, J. (Viking Systems International, Pittsburgh, PA (USA)). 30 Jun 1987. Contract AC22-86PC91801. 238p. NTIS, PC A11/MF A01; 1; GPO Dep. Order Number DE88000073/JAW.

The United States Agency for International Development (AID), in joint collaboration with the Government of India (GOI), supported a research and development program in Alternate Energy Resources during the period March 1983 to June 1987. The primary emphasis of this program was to develop new and advanced coal and biomass conversion technologies for the efficient utilization of coal and biomass feedstocks in India. This final "summary" report is divided into two volumes. This Report, Volume I, covers the program overview and coal projects and Volume II summarizes the accomplishments of the biomass projects. The six projects selected in the area of coal were: Evaluation of the Freeboard Performance in a Fluidized-Bed Combustor; Scale-up of AFBC boilers; Rheology, Stability and Combustion of Coal-Water Slurries; Beneficiation of Fine Coal in Dense Medium Cyclones; Hot Gas Cleanup and Separation; and Cold Gas Cleanup and Separation.

20751 (ERP/CRL—87-10-TR) Research directions and concerns in Canadian coal preparation: an operational perspective. Anderson, N.E.; Nikhail, M.W.; Salama, A.I.A.; Humeniuk, O.E. (Canada Centre for Mineral and Energy Technology, Devon, Alberta. Coal Research Centre Devon). Feb 1987. 27p. Canada Centre for Mineral and Energy Technology, Devon, Alberta. Coal Research Centre, Devon.

This report presents the results of a visit by a delegation of CANMET representatives to twelve Canadian coal preparation plants. Industry viewpoint, feedback and problems are reported briefly. Areas identified as those of interest and/or concern include: fines treatment (mobile plants), deep cleaning and coal-water mixtures technology; process control and a variety of operational concerns such as dewatering of coal, dust control, and health and safety concerns. 5 tabs.

20752 (NERDDP-EG—85-441) Surface chemistry of fine coal processing. Healy, T.W. (National Energy Research, Development and Demonstration Council, Canberra (Australia)). 1984. vp. Department of Resources and Energy, GPO Box 858, Canberra, ACT 2601, Australia.

The report presents details of an extensive study on the solution chemistry, interfacial chemistry (solid aqueous solution and air aqueous solution), oil/water partitioning and wettability characteristics of some commercial polydispersion ionic surfactants and short chain alcohols commonly used, or potentially useful, as frothers in fine coal processing.

20753 (PSI—1024/TR-762) Transformations of inorganic coal constituents in combustion system: Quarterly report No. 5, October-December 1987. (PSI Technology Co., Andover, MA (USA)). 28 Jan 1988. Contract AC22-86PC90751. 259p. NTIS, PC A12/MF A01; 1; GPO Dep. Order Number DE88005702/JAW.

During this reporting period, activities are reported for each of the subcontractors working on this project. At Foster-Wheeler Development Corporation, procurement and acquisition of coals has been completed. Analysis of the Kentucky No. 9 was performed and a data summary for the Upper Freeport, Eagle Butte and Beulah coals provided. The investigators at the University of Kentucky completed Computer Controlled Scanning Electron Microscopy (CCSEM) and Mossbauer mineralogical analyses for the Upper Freeport, Beulah, Eagle Butte, Kentucky No. 9, and San Miguel coals. At the California Institute of Technology, experiments have been performed in the Cal Tech reactor on calcium vaporization from synthetic chars. Differences in the vaporization rate have been noted, and a catalytic effect (related to the presence of the mineral/char interaction) on the char combustion rate has been found. At the Massachusetts Institute of Technology, continued progress has been made on the development and exercise of the site percolation model to describe char fragmentation and the contribu-

tions of this process to the residual ash size distribution. Work at the University of Arizona has centered on defining and incorporating improvements into the sampling and analysis system used to sample ash from their pulverized coal combustion facility. At PSI, work was focused principally on preparation for a test series oriented toward collection of ash particles in situ. This collection will permit a determination of their surface state (composition and phase), and to identify mechanisms related to the propensity of such particles to stick and form deposits.

20754 **Explosive comminution of bituminous coal using steam.** Hang, T.; Mathur, M.P.; Narain, N.K.; Smith, D.N.; Ruether, J.A. (USDOE Pittsburgh Energy Technology Center, PA). *Energy and Fuels;* **1**: No. 6, 529-534(Nov-Dec 1987).

The explosive comminution of Illinois No. 6 coal (Burning Star mine) was performed with steam in a batch reactor. Parametric studies were conducted to investigate the effects of key variables, such as temperature (347-506 degrees C), pressure (2400-5000 psig), coal slurry concentration (14%-75%), and heating rate, on both the particle size reduction and the desulfurization. Data on particle size reduction and SEM (scanning electron microscopy) micrographs provided evidence that the thermoplastic properties (softening, swelling, etc.) probably played a major role in explosive comminution. Coal was comminuted most effectively at temperatures in the plastic range. Volume mean particle size was typically reduced from 90 μm to the range of 15-40 μm by treatment; using lump coal feed resulted in an even finer product. Sulfur removal as H_2S fell in the range 6%-15%, but it could not be determined if any organic sulfur was removed. 21 refs., 6 figs., 8 tabs.

0104 Processing

REFER ALSO TO CITATION(S) 20750, 20750, 20753, 20754, 20906, 20907, 20911, 20912, 20914, 21178, 21441, 21979

20755 **(ARL-TR—46) Vacuum pyrolysis of Prince Mine coal.** Roy, C.; DeCaumia, B. (National Research Council of Canada, Halifax, Nova Scotia). 1984. 49p. National Research Council of Canada, Halifax, Nova Scotia.

Some of the variables affecting the thermal decomposition reaction of Prince Mine (Nova Scotia) coal under vacuum in laboratory experiments were examined. Results of tests on temperature, particle size, pressure, carrier gas, residence time of vapors, and addition or not of lime to raw coal are provided. The influence of these variables on factors such as product yields and quality was investigated. 3 refs., 9 figs., 6 tabs.

20756 **(ARL-TR—47) Pyrolysis of coal-lime mixtures. Pt. IV - Analysis of pyrolysis products - char, condensate and gas.** Brothers, J.A.; Crandelmire, A.L. (National Research Council of Canada, Halifax, Nova Scotia). 1984. 31p. National Research Council of Canada, Halifax, Nova Scotia.

This is the fourth part of a study to examine pyrolysis of the bituminous coals of Atlantic Canada. This report presents results of a series of pyrolysis tests carried out to monitor the effects of temperature, heating rate, coal-preoxidation, hydrogen addition, use of steam, etc. on pyrolysis products - char, condensate and gas. Most of the product is char - 60-80% of MAF coal on an ash-free weight basis for pyrolysis conditions. Carbon liquid yields of up to 16%, and gas yields varying from 7% at 550 degrees C to 18% at 900 degrees C, have also been obtained. 12 refs.

20757 **(ARL-TR—50) Microbiological studies on high-sulphur coals.** McCready, R.G.L. (National Research Council of Canada, Halifax, Nova Scotia). 1984. 76p. National Research Council of Canada, Halifax, Nova Scotia.

This project was undertaken to investigate the SABA process of coal beneficiation and a number of other microbiological factors affecting coal preparation processes. Eastern Canadian coals, which have a high sulfur content, were used in the investigation. The work can be separated into five categories: 1) isolation and cultivation of indigenous T. ferrooxidans from Cape Breton coal wastes; 2) selective adsorption of 32P-labelled T. ferrooxidans in finely ground coal suspension; 3) studies on iron sulfide and ash rejection; 4) bacterial leaching of iron sulfides from coal; and, 5) ancillary basic studies on nutrition, fimbriae, plasmids and predator organisms. 33 refs., 6 figs., 24 tabs.

20758 (CONF-8410328—, pp 9, Paper 1) **Novel carbon molecular sieve catalysts for wax suppression in the Fischer-Tropsch reaction.** 1984. NTIS, PC A20/MF A01. Order Number DE88005251/JAW.

From 4. DOE contractors' conference on indirect liquefaction; Washington, PA, USA (30 Oct 1984).

The objective of this contract will be to develop new inorganic oxide-containing carbon molecular sieves (CMS) for the direct conversion of synthesis gas into a non-Schulz-Flory distribution of hydrocarbon products. The project breaks into two distinct parts; proof of the inorganic oxide-carbon molecular sieve concept, and testing the materials in the Fischer-Tropsch reaction. A major emphasis of this project will be upon extremely careful experimental design, sample recovery, and product analysis. In this way experimental artifacts will not lead to false conclusions regarding the selectivity of these materials as Fischer-Tropsch catalysts.

20759 (CONF-8410328—, pp 21, Paper 2) **Direct synthesis of 2-methyl-1-propanol/methanol fuels and feedstocks.** Klier, K.; Herman, R.G.; Simmons, G.W. (Lehigh Univ., Bethlehem, PA). 1984. NTIS, PC A20/MF A01. Order Number DE88005251/JAW. Contract AC22-84PC70021.

From 4. DOE contractors' conference on indirect liquefaction; Washington, PA, USA (30 Oct 1984).

The objective of this new research project is to provide a technological and scientific foundation for the synthesis of 2-methyl-1-propanol/methanol fuels and basic chemicals from synthesis gas. These mixtures are excellent high octane fuels, can be blended with hydrocarbon gasoline, have high energy densities in the 2-methyl-1-propanol portion, and have synthesis stoichiometries that can be adjusted to the various H_2/CO ratios produced by different gasifiers and feedstocks. The two principal tasks involve the following lines of research: (i) the development and optimization of Cs/Cu/ZnO support catalysts wherein the cesium component provides a very effective basic function that steers the synthesis toward 2-methyl-1-propanol, and (ii) the development of a kinetic reaction network that will be usable for reactor design, as well as for predictions of reaction conditions that give rise to the required 2-methyl-1-propanol/methanol composition in the reactor exit stream. 31 references.

20760 (CONF-8410328—, pp 7, Paper 3) **Synthesis gas solubility in Fischer-Tropsch slurry.** Lin, H.M.; Chao, K.C. (Purdue Univ., West Lafayette, IN). 1984. NTIS, PC A20/MF A01. Order Number DE88005251/JAW.

From 4. DOE contractors' conference on indirect liquefaction; Washington, PA, USA (30 Oct 1984).

The objective of this research is to investigate the phase equilibrium behavior of synthesis gas and Fischer-Tropsch products in slurry media. Measurements will be made in a semi-flow apparatus at conditions of temperature and pressure typical of those found in Fischer-Tropsch slurry reactors. The data will be used to develop correlation methods.

20761 (CONF-8410328—, pp 13, Paper 4) **Micelle derived catalysts for extended Schulz-Flory.** 1984. NTIS, PC A20/MF A01. Order Number DE88005251/JAW. Contract AC22-84PC70023.

From 4. DOE contractors' conference on indirect liquefaction; Washington, PA, USA (30 Oct 1984).

The objective of this program is to develop novel Fischer-Tropsch catalysts for the selection synthesis of gasoline or diesel range fuels from synthesis gas. Recent work indicates that in Fischer-Tropsch limiting the particle size can be used to provide a cut-off for the upper-end of the hydrocarbon distribution and, therefore, provide substantial deviation from the Anderson-Schulz-Flory polymerization law: the higher the chain growth probability prior to cut-off, the more dramatic the deviations. Supported ruthenium catalysts with specific size metal particles will be prepared using a proprietary micelle procedure. Catalysts prepared with this technique will be characterized for geometric and electronic properties using STEM, XRD, SAXS, EXAFS, and ESCA. Selected catalysts

will be tested under operating conditions that favor high chain growth probability. The specific size distribution of the catalysts will be designed to provide a product distribution cut-off at the desired product. Catalyst screening will be implemented in a fixed-bed pilot plant unit. A slurry unit will later be used for catalyst optimization and stability studies. Existing UOP gas chromatographic methods, i.e., total gas analysis, hydrocarbons by boiling point will be used to analyze reaction products. For selected runs, more detailed product characterization will be achieved by using MS, IR, and C-13 NMR.

20762 (CONF-8410328—, pp 14, Paper 5) **Hydrodynamics of Fischer-Tropsch synthesis in slurry bubble column reactors.** Bukur, D.B.; Tatterson, G.B. (Texas A & M Univ., College Station). 1984. NTIS, PC A20/MF A01. Order Number DE88005251/JAW. Contract AC22-84PC70027.

From 4. DOE contractors' conference on indirect liquefaction; Washington, PA, USA (30 Oct 1984).

The objectives of their study is (1) to operate bubble columns (2" and 9" in diameter) using the Fischer-Tropsch (FT) wax as a liquid medium, (2) to perform studies on different flow regimes, (3) to determine spatial bubble size and number distributions and gas hold-up for the important flow regimes, as well as their average values, (4) to obtain empirical correlations for calculation of average gas hold-up and gas liquid interfacial area, and (5) to investigate the effects of minor amounts of oxygenated compounds on the hydrodynamics and foaming characteristics of the FT wax. For the small bubble flow regime; bubble number and bubble size distributions will be obtained using a suction line and/or a dip stick method to obtain liquid samples as a function of axial position and operating conditions. The liquid samples will be rapidly frozen, sectioned and photographed for subsequent analysis. For other flow regimes, high speed motion pictures will be used and analyzed to obtain the necessary data. The information gained from this research will be useful for the design of large bubble column reactors for the FT synthesis, and will help to prevent serious operational problems due to improper scale-up procedures.

20763 (CONF-8410328—, pp 13, Paper 6) **Diffusivities of synthesis gas and Fischer-Tropsch products in slurry media.** Akgerman, A. (Texas A & M Univ., College Station). 1984. NTIS, PC A20/MF A01. Order Number DE88005251/JAW. Contract AC22-84PC70032.

From 4. DOE contractors' conference on indirect liquefaction; Washington, PA, USA (30 Oct 1984).

Fischer-Tropsch process normally takes place in a slurry reactor where the synthesis gas diffuses through the liquid wax to the catalyst surface, into the catalyst pores if any, react, and the products diffuse out in a similar fashion. Design of the Fischer Tropsch process requires this mass transfer rate which in turn necessitates the diffusion coefficients at the process conditions. In this study they propose to develop and construct an apparatus to measure diffusion coefficients of CO, H_2, and some Fischer Tropsch products in Fischer-Tropsch wax at 120-300°C temperature and 1-35 atm pressure. They will use a dispersion technique in which a pulse of the solvent saturated with the diffusing component is injected into a stream of pure solvent in laminar flow in a long circular capillary. Dispersion of the injected pulse is then affected by longitudinal molecular diffusion and by Taylor dispersion. Diffusion coefficients can be calculated from the first and second moments of the dispersion of the square pulse.

20764 (CONF-8410328—, pp 12, Paper 7) **Optimum fuel alcohol mixtures from syngas.** McKinley, D.L. (Union Carbide Corp.). 1984. NTIS, PC A20/MF A01. Order Number DE88005251/JAW.

From 4. DOE contractors' conference on indirect liquefaction; Washington, PA, USA (30 Oct 1984).

The objective of their program is to develop and evaluate homogeneous catalytic systems for the direct, selective conversion of syngas to alcohol fuel extenders. A homogeneous process would offer a number of significant benefits over existing technology for higher alcohol synthesis, both because of the homogeneous process concept and because homogeneous catalysts are expected to produce most efficiently the optimum alcohols for use as fuel extenders. Several approaches will be pursued in the catalyst research program. The catalytic systems which are presently known to convert syngas to higher alcohol products in the homogeneous phase are based on cobalt, rhodium, and ruthenium. The ruthenium catalyst system which was discovered at Union Carbide will be the subject of a substantial research effort because of its relatively high activity, good stability, and the potential for modifying its product selectivity. Current knowledge of the catalytic mechanisms in this area will be an initial guide in attempting to further increase the activity and selectivity to higher alcohol products. Another approach in this research program will be to explore more broadly the possibilities for novel syngas conversion catalysts with improved performance. The major direction of the research in this part of the program will be toward metal systems not previously known to have significant activity in homogeneous CO hydrogenation reactions. Fundamental studies related to the catalytic reactions of interest will also be pursued, since they form the base of knowledge required to modify existing systems or to develop novel catalysts.

20765 (CONF-8410328—, pp 7, Paper 8) **Mechanism of promotion of iron Fischer-Tropsch catalysts.** Davis, B.H. (Univ. of Kentucky, Lexington). 1984. NTIS, PC A20/MF A01. Order Number DE88005251/JAW. Contract AC22-84PC70029.

From 4. DOE contractors' conference on indirect liquefaction; Washington, PA, USA (30 Oct 1984).

The proposed research will utilize a kinetic isotope method (KIM) to explore the role of promoters in altering chain initiation and/or growth for iron Fischer-Tropsch catalysts. This method was used in a limited study by Emmett in the 1950-60's. The author was able to demonstrate that some compound classes were rather inert in the synthesis conditions while other compounds served to initiate chain growth. In the present study several compound classes will be utilized in the KIM studies. Both low (1-2 carbon) and higher (5-10 carbon) molecular weight compounds will be included in this study. Initial runs will be a commercial catalyst (C-73 from United Catalysts, Inc.). The study will utilize basic promoters selected from Group IA and IIA, with emphasis on the first.

20766 (CONF-8410328—, pp 5, Paper 9) **Transient-kinetic study of the initial behavior of Raney nickel in methanation.** Soong, Y.; Krishna, K.; Biloen, P. (Univ. of Pittsburgh, PA). 1984. NTIS, PC A20/MF A01. Order Number DE88005251/JAW.

From 4. DOE contractors' conference on indirect liquefaction; Washington, PA, USA (30 Oct 1984).

The authors report on phenomena accompanying the first eighty hours of exposure of a Raney Nickel catalyst to hydrogen-lean syngas. Data regarding the catalyst, reaction conditions and steady-state activity are being given in a table. The steady-state activity declines some 20% in the first eighty hours on stream. During this period they repeatedly switched the feed from $^{13}CO/H_2$ to $^{13}CO/H_2$ and vice versa. As the authors abruptly replace a given partial pressure of ^{13}CO by the same partial pressure of ^{13}CO, and as ^{12}CO and ^{13}CO have virtually identical chemical reactivity, the total CH_4 production proceeds unperturbed. A transient decrease of $^{12}CH_4$ is being compensated by a transient increase of $^{13}CH_4$. This procedure therefore allows them to obtain transient-kinetic data without perturbing the steady-state surface chemistry. It emerges that during the initial stage of exposure of a second reservoir of intermediates develops. After 80 hours this reservoir is responsible for approximately 1/3 of the total methane production.

20767 (CONF-8410328—, pp 2, Paper 10) **Determination of carbonaceous overlayer precursors.** Montano, P.A.; Cooper, B.R. (West Virginia Univ., Morgantown). 1984. NTIS, PC A20/MF A01. Order Number DE88005251/JAW.

From 4. DOE contractors' conference on indirect liquefaction; Washington, PA, USA (30 Oct 1984).

The authors are making and characterizing multimetallic catalyst surfaces (Fe, Mn, Co, on Cu or Mn), and studying the formation thereon of carbonaceous overlayers characteristic of Fischer-Tropsch synthesis reaction involving a variety of gases. The emphasis shall be on the use of novel x-ray absorption techniques (XANES and EXAFS), and coordinated self-consistent electronic

structure calculations, to characterize the multimetallic surfaces and the species formed in the reactions. Experimental parameters of temperature and pressure shall be studied. Bonding and geometry of the intermediate and final species shall be found, and these shall be related to the predictions and results of the self-consistent electronic-structure calculations of geometrical aspects and binding energy which affect carbon reactivity. All the measurements shall be performed in situ using previously developed techniques. The authors shall assess the importance of carbon site selection on varied multimetallic surfaces and identify the most reactive species toward formation of carbonaceous overlayers on F-T catalysts. Improvement potential in catalyst activity and resistance toward poisoning shall be evaluated through tailoring of the catalyst surface and the surface electronic structure by addition of other transition metals. To relate the results to catalytic systems of current practical interest, the authors shall initiate studies using the new x-ray absorption techniques, and related self-consistent electronic-structure calculations, on real supported uni- and multimetallic catalysts (e.g., ThO_2, Fe-Co on zeolites, Fe-Mn catalysts).

20768 (CONF-8410328—, pp 41, Paper 11) **Two-stage indirect liquefaction.** Kuo, J.C.W.; Smith, J.; Leib, T.M.; Gupte, K.M. (Mobil Research and Development Corp., Paulsboro, NJ). 1984. NTIS, PC A20/MF A01. Order Number DE88005251/JAW. Contract AC22-83PC60019.

From 4. DOE contractors' conference on indirect liquefaction; Washington, PA, USA (30 Oct 1984).

The authors have modified their two-stage Fischer-Tropsch/ZSM-5 pilot plant to improve operations, and have performed evaluation runs on two different catalysts. Both runs demonstrated low (< 4.8 wt %) methane + ethane selectivity, while reactor-wax yields ranged from 35 to 75 wt % of hydrocarbons produced. A proprietary on-line reactor-wax/catalyst separation system worked to perfection, producing reactor-wax with a solids content of less than 0.1 wt %. High-pressure operation was shown to have a detrimental effect on one of the catalysts studies, while the other apparently was unaffected. Also, during the second evaluation, a single-orifice feed-gas distributor was tested in the first-stage bubble-column reactor for the first time. Advances in analytical techniques have enabled the authors to identify a large fraction of high-boiling hydrocarbons in their reactor-wax samples. In certain cases, a bimodal carbon number distribution has been shown to exist, and this has in turn modified the Shulz-Flory product distribution reported last year.

20769 (CONF-8410328—, pp 25, Paper 12) **Techno-economic assessment of the Mobil two-stage slurry Fischer-Tropsch/ZSM-5 process.** 1984. NTIS, PC A20/MF A01. Order Number DE88005251/JAW.

From 4. DOE contractors' conference on indirect liquefaction; Washington, PA, USA (30 Oct 1984).

Mobil Oil has investigated a modified slurry phase Fischer-Tropsch concept in a continuous bench-scale unit with DOE support. The Mobile two stage Fischer-Tropsch process incorporates a slurry-phase Fischer-Tropsch unit closely coupled to a fixed bed zeolite (ZSM-5) reactor. The objective was to produce finished high-octane gasoline with minimal additional downstream refining. DOE requested that MITRE carry out an assessment of the Mobile two stage Fischer-Tropsch program. Following the detailed assessment of the bench-scale runs, MITRE carried out economic analyses of commercial-size plants, using the experimental test run data from the Mobile two-stage SFT/ZSM-5 benchscale unit. These data were scaled to provide a conceptual design for commercial-size plants with a total coal input of 27,800 tons of as-received Wyoming coal per day. These commercial plants utilized the British Gas Corporation Slagging Lurgi (BGC) gasifier for the production of synthesis gas. Predicted thermal efficiency, product slate, capital cost, operating cost, annual revenue requirement, and unit product cost of such commercial facilities are compared to the corresponding figures for the reference cases. Six cases are examined in this report. Three of these cases involve various versions of Mobil's two stage SFT/ZSM-5 process. The other three cases are provided for comparison purposes and include a SASOL-like or SASOL (US) case which uses a dry ash Lurgi gasifier and Synthol synthesis units, a BGC/Synthol case, and a slurry-phase Fischer-Tropsch case identified as the BGC/Koelbel case. The three cases all include refining of raw Fischer-Tropsch gasoline to market grade, high octane gasoline and alkylation of C_3-C_4 olefins to additional gasoline. Marketable diesel fuel and fuel oil are produced. Results are discussed.

20770 (CONF-8410328—, pp 47, Paper 13) **Selective slurry phase catalysts for Fischer-Tropsch synthesis.** Bohling, D.A.; Carroll, W.E.; Cilen, N.; Motika, S.A. (Air Products and Chemicals, Inc.). 1984. NTIS, PC A20/MF A01. Order Number DE88005251/JAW. Contract AC22-80PC30021.

From 4. DOE contractors' conference on indirect liquefaction; Washington, PA, USA (30 Oct 1984).

The slurry phase Fischer-Tropsch (F-T) process for converting coal derived synthesis gas into liquid fuels offers advantages in thermal efficiency and economics over the conventional vapor phase F-T process, when coupled with advanced coal gasifiers which produce syngas feedstocks with a low H_2/CO ratio. Air Products has developed novel slurry phase Fischer-Tropsch catalysts which produce yields of fuel range hydrocarbons greater than the limitations of the Schulz-Flory distribution. For example, at a CO/H_2 ratio of 2, yields of up to 65 wt % hydrocarbon product in the diesel fuel range are possible; product selectivity is influenced significantly by the CO partial pressure. The stability of these catalysts in the presence of carbon monoxide-rich synthesis gas has been demonstrated by extended testing. This paper describes results obtained with both coprecipitated and supported cluster catalysts, all of which yield enhanced selectivity in the fuel product range. Computer simulations indicate that these catalysts have the potential to produce significantly higher space time yields in the diesel fuel range than was observed in the Rheinpreussen slurry reactor. Studies on the effects of catalyst composition and pretreatment on selectivity and activity will be described for the coprecipitated iron catalyst series.

20771 (CONF-8410328—, pp 36, Paper 14) **Fischer-Tropsch bubble-column hydrodynamics.** Gupte, K.M.; Smith, J.; Leib, T.M.; Kuo, J.C.W. (Mobil Research and Development Corp., Paulsboro, NJ). 1984. NTIS, PC A20/MF A01. Order Number DE88005251/JAW. Contract AC22-83PC60019.

From 4. DOE contractors' conference on indirect liquefaction; Washington, PA, USA (30 Oct 1984).

Two tall non-reacting hot-flow bubble-columns (5.1 and 10.2 cm ID x 9.1 m L) have been constructed for hydrodynamic studies. One sintered-metal-plate (SMP) and two orifice-type feed-gas distributors have been evaluated using the 5.1 cm ID column and a F-T derived paraffinic wax as a liquid medium. The results show that the gas distributor design, static liquid height, and gas superficial velocity have a major effect on gas holdup. For instance, orifice distributors give substantially lower gas holdups than the SMP distributor. To obtain bubble size distributions, photographs of the bubble-flow-patterns were taken and dynamic disengagement experiments were carried out. Scoping hydrodynamic studies in short hot-flow bubble-columns (3.2 and 5.3 cm ID x 2.2 m L) show that different waxes behave differently, and that type of gas distributor can have a major effect on gas holdup and bubble sizes. Lastly, gas holdups under reaction conditions have been obtained using a new DP-cell setup in the 5.2 cm ID x 7.6 m L F-T reactor of the two-stage BSU with two different feed-gas distributors.

20772 (CONF-8410328—, pp 31, Paper 15) **Slurry F-T reactor hydrodynamics and scale-up.** Smith, D.N.; O'Dowd, W.; Ruether, J.A.; Stiegel, G.J.; Shah, Y.T. (Pittsburgh Energy Technology Center, PA). 1984. NTIS, PC A20/MF A01. Order Number DE88005251/JAW.

From 4. DOE contractors' conference on indirect liquefaction; Washington, PA, USA (30 Oct 1984).

The Fischer-Tropsch (F-T) synthesis of hydrocarbons by the hydrogenation of carbon monoxide over a catalyst via the indirect liquefaction route has only been demonstrated on a commercial scale in fixed-bed and entrained-bed reactors. The slurry reactor has been found to offer important advantages, such as low H_2/CO feed ratios and isothermal stability on the laboratory and pilot-plant scale. Recent findings concerning slurry bubble column hydrodynamics are presented, and their relevance to slurry F-T reactor design and scale-up are discussed. The need for optimization of a slurry F-T reactor is apparent owing in large part to the nonselective forma-

tion of products on the catalyst, and the influence of hydrodynamics on the overall conversion of reactants. In this regard, the important transport resistances in the formation of products, and the influence of reactor dimensions on reactor performance are discussed.

20773 (CONF-8410328—, pp 28, Paper 16) **100 bpd fluid bed methanol-to-gasoline operations at Wesseling, Germany.** Kane, S.E.; Gould, R.M.; Edwards, M.S. (Mobile Research and Development Corp.). 1984. NTIS, PC A20/MF A01. Order Number DE88005251/JAW.

From 4. DOE contractors' conference on indirect liquefaction; Washington, PA, USA (30 Oct 1984).

Evaluation of the fluid-bed Methanol-to-Gasoline (MTG) process is progressing smoothly in the 100 bpd pilot plant in West Germany. The project is being conducted jointly by Mobil Research and Development Corporation, Uhde GmbH, and Union Rheinische Braunkohlen Kraftstoff AG (URBK). The project is supported financially by the US DOE and the German Government. Following a brief shakedown period, the plate was started up in December, 1982 at the URBK facility near Cologne. The plant has accumulated over 8000 hours on stream at feed rates of up to 200 bpd methanol. The first operational phase of the project was completed as scheduled in September, 1983. Plant performance met or exceeded all design goals. Finished gasoline yields of 90 wt % of total hydrocarbons were achieved at base case conditions with complete methanol conversion. Gasoline octane was 95-96 Research clear. Preliminary tests indicate that product stability is excellent. Process sensitivity studies indicate the potential for increased yields and improved operation at the expense of product octane. A second phase of operation is currently underway to evaluate improved heat removal and other process options.

20774 (CONF-8410328—, pp 35, Paper 17) **Results of LaPorte liquid phase methanol PDU operation.** Tsao, T.R. (Air Products and Chemicals, Inc., Allentown, PA). 1984. NTIS, PC A20/MF A01. Order Number DE88005251/JAW.

From 4. DOE contractors' conference on indirect liquefaction; Washington, PA, USA (30 Oct 1984).

Liquid Phase Methanol (LPMEOH) technology has the potential to be a lower-cost conversion route to methanol-from-coal than current gas phase processes. A US Department of Energy-sponsored, 42-month research and development program to demonstrate the feasibility of LPMEOH technology at the Process Development Unit (PDU) scale is in its final stage. The program began in October 1981. A DOE-owned, skid mounted PDU was transferred from Chicago to Air Products' LaPorte, TX facility, refurbished, and expanded for serve as the LPMEOH PDU. The PDU employs a unified design concept, allowing operation in either the liquid-fluidized (ebullated bed) or liquid-entrained (slurry) mode. The construction of the LaPorte PDU was completed in October 1983. Commissioning of the PDU began in November 1983 and was completed in early 1984. Three PDU runs, two with a catalyst extrudate specially made for liquid-fluidized operation and one with a commercially available powder catalyst, were completed in the past year. The catalyst extrudates attrited to powdered slurry form rapidly. During the transition from extrudates to slurry, and at the complete slurry state, the PDU performed well. Process performance and catalyst activity over a wide range of operational conditions were investigated. Methanol production ranged from 1.8 to 8.0 TPD. A 40-day run was accomplished with CO-rich feed gas.

20775 (CONF-8410328—, pp 31, Paper 18) **Fischer-Tropsch synthesis in slurry reactor systems.** Satterfield, C.N.; Stenger, H.G. Jr. (Massachusetts Institute of Technology, Cambridge). 1984. NTIS, PC A20/MF A01. Order Number DE88005251/JAW. Contract FG22-81PC40771.

From 4. DOE contractors' conference on indirect liquefaction; Washington, PA, USA (30 Oct 1984).

With a reduced fused magnetite catalyst, the rate of synthesis in the presence of phenanthrene is nearly twice that observed in the presence of n-octacosane ($C_{28}H_{58}$) even though the solubility of H_2 and CO is moderately less in phenanthrene. Secondary reactions such as olefin hydrogenation and olefin isomerization were slightly less in phenanthrene at lower temperatures, attributed to competitive adsorption effects. These and other secondary reactions are markedly enhanced at high conversions at which CO concentrations are low. The presence of dibenzothiophene decreases catalyst activity but also causes a marked drop in selectivity to form methane and an increase in olefin-paraffin ratio of products, indicating that it decreased the hydrogenation capability of the catalyst. These effects did not occur with H_2S poisoning.

20776 (CONF-8410328—, pp 16, Paper 19) **Bifunctional F-T catalyst development.** 1984. NTIS, PC A20/MF A01. Order Number DE88005251/JAW. Contract AC22-81PC40077.

From 4. DOE contractors' conference on indirect liquefaction; Washington, PA, USA (30 Oct 1984).

Union Carbide and the US Department of Energy have recently signed a two-year contract, Improved Catalysts for Liquid Hydrocarbon Fuels from Syngas. The purpose of this new contract is to further improve and to economically evaluate catalysts developed under a previous contract, Liquid Hydrocarbon Fuels from Syngas, which began March, 1981. These catalysts contain both a Fischer-Tropsch (F-T) active metal component (MC) and a molecular sieve shape selective component (SSC). The current MC contains cobalt which has been modified by the addition of proprietary promoters to improve the catalyst's selectivity and stability. The metal component is placed in close contact with a Union Carbide proprietary molecular sieve, and the synergism caused by this interaction further increases the catalyst's stability. These catalysts are particularly stable at low H_2:CO conditions. Syngas conversion and yield data obtained from Berty reactors were used to derive a rate expression and selectivity correlations for these F-T catalysts. These correlations, used to predict the catalyst's performance in a tubular reactor, showed that methane decreased and liquid product increased as the syngas environment became more CO rich. The unusually high stability of this catalyst in such an environment thus allows it to operate at conditions most conducive to low yields of methane and high yields of motor fuels.

20777 (CONF-8410328—, pp 33, Paper 20) **Role of secondary reactions on the selectivity of metal-zeolite catalysts in synthesis gas conversion.** Rao, V.U.S.; Gormley, R.J.; Schehl, R.R. (Pittsburgh Energy Technology Center, PA). 1984. NTIS, PC A20/MF A01. Order Number DE88005251/JAW.

From 4. DOE contractors' conference on indirect liquefaction; Washington, PA, USA (30 Oct 1984).

Aspects of selectivity of metal-zeolite catalysts in synthesis gas conversion connected with secondary reactions on the metal surface are considered. The influence of the preparative method on the selectivity of cobalt-ZSM-5 catalysts in synthesis gas conversion has been investigated. The catalysts prepared by impregnation using an organometallic compound exhibit the highest metal dispersion, highest conversion per gram of cobalt and the lowest selectivity to aromatics. Catalysts prepared by the physical admixture of precipitated cobalt with ZSM-5 exhibit highest selectivity to aromatics. There is a correlation between the methane yield and the percent aromatics in the liquid hydrocarbon product. The connection between the selectivities to aromatics and methane can be traced through the formation of additional alkanes (C_3H_8 and C_4H_{10}) in the hydrogen transfer reactions accompanying the aromatization process. The alkanes appear to undergo hydrogenolysis over cobalt leading to the formation of additional methane. However, conversion of synthesis gas in two steps over separated cobalt and ZSM-5 catalyst beds does not result in additional methane, supporting the above hypothesis. Addition of thoria as a promoter to cobalt in the bifunctional catalyst reduces methane yield as well as the fraction of aromatics. Co-ThO_2-ZSM-5 catalysts provide nearly 70% yield of gasoline-range product from synthesis gas. Other possible methods for reducing methane yield, such as using alloy catalysts for the FT component, are considered.

20778 (CONF-8410328—, pp 15, Paper 21) **Reactivity and surface chemical speciation of Fe-Cu and Fe-Mn liquefaction catalysts.** Stencel, J.M.; Pennline, H.W.; Diffenbach, R.A. (Pittsburgh Energy Technology Center, PA). 1984. NTIS, PC A20/MF A01. Order Number DE88005251/JAW.

From 4. DOE contractors' conference on indirect liquefaction; Washington, PA, USA (30 Oct 1984).

The activity and surface speciation of 20Fe/80Mn and Fe-Cu liquefaction catalysts are discussed. The effect of the process parameters of temperature, pressure, and reducing gas composition on the activation step and on the subsequent catalyst activity and product selectivity were studied for Fe/Mn catalysts. Also, the alkali promotion of the iron-manganese with potassium carbonate was investigated. Slurry samples were taken at various times on stream, and these Fe/Mn catalysts were analyzed by surface techniques so that the catalyst properties could be correlated with process results. Microreactor tests were performed on Fe-Cu catalysts, in addition to TGA, ISS, and XPS studies as a function of H_2 and CO exposure. These studies are discussed with respect to the activity/selectivity of Fe-Cu catalysts.

20779 **(DOE/ER/13481—3) Reduction of coal, coal oils and functionalized aromatic compounds derived from coal by calcium in amines: Annual technical progress report, February 1-December 31, 1987.** Benkeser, R.A. (Purdue Univ., Lafayette, IN (USA)). Jan 1988. Contract FG02-86ER13481. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004746/JAW.

Results are reported for the reduction of indole, benzothiophenes, benzofuran, phenylacetic acids and carbazole. The reduction of indole to 4,5,6,7 tetrahydroindole is a unique one step reaction. The reducing agent used was a calcium-amine reagent. Lithium was also used, but was not as effective. Studies on the reduction of alkylated benzoic acids have begun. Initial results indicate that no hydrogen is evolved until the aromatic ring is reduced to dihydroproducts. (CBS)

20780 **(DOE/FC/10620—2535) Low-rank-coal research: Quarterly technical progress report for the period January 1, 1987-March 31, 1987.** Powell, E.A.; Zinn, B.T. (Georgia Inst. of Tech., Atlanta (USA). School of Aerospace Engineering). Apr 1987. Contract AC21-84FC10620. 14p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004326/JAW.

The parametric studies were continued to determine the effect of increasing the pulsation amplitude upon the production rates of CO and H_2 for the model gasifier. The physical mechanisms by which pulsations increase the CO and H_2 production rates were also investigated. The experimental pulsating gasifier and its safety systems were improved, and the ranges of air/fuel ratios and methane fuel flow rate for pulsating operation without coal feed were established. 7 figs.

20781 **(DOE/FE/60177—2450) Three-dimensional laboratory simulation of the pressure dependency of UCG [underground coal gasification].** Glaser, R.R.; Johnson, L.A. Jr. (Western Research Inst., Laramie, WY (USA)). Oct 1985. Contract FC21-83FE60177. 32p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006024/JAW.

Western Research Institute conducted a series of laboratory tests of underground coal gasification (UCG) at 100, 300, and 500 psig to investigate the effects of pressure on UCG product gas quality. Pressure did not significantly influence methane production rates because high temperatures thermodynamically exclude methanation as a principal producer of methane. The methane produced in these experiments ws the result of pyrolysis reactions. Hydrogen and carbon monoxide production decreased in the higher pressure tests, as expected from chemical equilibrium calculations. Mass transfer influences on the cavity wall growth rates were indicated by the strong dependency of air mass flux on gas quality observed in all three experiments. The difference noted between steeply dipping bed and horizontal underground coal gasification performance as a function of pressure is probably attributable to differences in reactor geometries. 12 refs., 11 figs., 4 tabs.

20782 **(DOE/FE/60877—T1) Feasibility study of application of UCG [underground coal gasification] to the Triunfo coal of Brazil: Final report.** (Brascep Engenharia Ltd., Rio de Janeiro (Brazil); Hammesfahr-Winter and Associates, Inc., Bernardsville, NJ (USA)). 21 Aug 1987. Contract FC01-86FE60877. 47p. NTIS, PC A03. Order Number DE88005840/JAW.

This paper aims to present the work done in the first section of a Phase 1 effort to develop a plan for UCG in Brazil, using the Controlled Retracting Injection Point (CRIP) method. The work described here is the first part of a lengthy phased program intended to culminate in a commercial plant facility. The results from the completed Phase I of which the work here reported is part, will be used to provide realistic cost data to evaluate the rest of the program. 2 refs.

20783 **(DOE/MC/22012—2542) Gasification of char in a membrane filter: Final report.** Hess, M.; Di Bella, C.A.W. (KOH Systems, Inc., Rockville, MD (USA)). Aug 1987. Contract AC21-85MC22012. 120p. NTIS, PC A06/MF A01; GPO Dep. Order Number DE88001040/JAW.

This report deals with the feasibility of reducing the amount of char on a barrier filter by in-place gasification. Compared to the very rapid pyrolysis step, the gasification of char on a filter requires substantial time under conditions that favor the gasification reactions. Three categories of information were of greatest interest: (1) The origin, characteristics and properties of the char. (2) The conditions under which the char was gasified and the rates and extents of the gasification reactions. (3) Any interpretation or mathematical modelling of the experimental results. 74 refs., 10 tabs.

20784 **(DOE/MC/23075—2534) Measurement and modeling of advanced coal conversion: Annual report, October 1, 1986-September 30, 1987.** Solomon, P.R.; Hamblen, D.G.; Serio, M.A.; Smoot, L.D.; Brewster, S. (Advanced Fuel Research, Inc., East Hartford, CT (USA); Brigham Young Univ., Provo, UT (USA)). Oct 1987. Contract AC21-86MC23075. 297p. NTIS, PC A13/MF A01; 1; GPO Dep. Order Number DE88001031/JAW.

The overall objective of this program is the development of computer-aided reactor engineering technology for the design, scale up, simulation, control and feedstock evaluation in advanced coal conversion devices. This technology, based on a systematic database and reactor simulation software, is important to reduce the technical and economic risks inherent in utilizing coal, a feedstock whose variable and often unexpected behavior presents a significant challenge. The foundation to describe coal-specific conversion behavior will be AFR's Functional Group (FG) and Devolatilization, Vaporization, and Crosslinking (DVC) models, developed under previous and on-going METC sponsored programs. These models have demonstrated the capability to describe the time dependent evolution of individual gas species, and the amount and characteristics of tar and char. The FG/DVC models will be integrated with BYU's comprehensive two-dimensional reactor model, PCGC-2, which is currently the most widely used reactor simulation for combustion or gasification. The program includes: (1) validation of the submodels by comparison with laboratory data obtained in this program, (2) extensive validation of the modified comprehensive code by comparison of predicted results with data from bench-scale and process scale investigations of gasification, mild gasification and combustion of coal or coal-derived products in heat engines, and (3) development of well documented user friendly software applicable to a "workstation" environment. Success in this program will be a major step in improving the predictive capabilities for coal conversion processes including: demonstrated accuracy and reliability and a generalized "first principles" treatment of coals based on readily obtained composition data.

20785 (DOE/METC—86/6043, pp 358-367) **Gas separations using ion exchange membranes.** Noble, R.D.; Way, J.D. (National Bureau of Standards, Boulder, CO). Jun 1986. NTIS, PC A18/MF A01. Order Number DE86006617/JAW. (CONF-860649—). Contract AI21-84MC21271.

From 6. annual gasification contractors' meeting; Morgantown, WV, USA (24 Jun 1986).

The most common separations problem in synthetic gas processing is the removal of acid gases (carbon dioxide and hydrogen sulfide), water, and nitrogen. Lurgi gasification of high sulfur (4.5%) bituminous coal can produce CO_2 mole fractions of 26% and H_2S mole fractions of 1.65% before shifting. The H_2S removal is required to prevent poisoning system catalysts, and to meet environmental restrictions. CO_2 removal is necessary to upgrade the gas to pipeline standards. Conventional processes for removing CO_2

and H_2S required absorption at feed stream pressure and subsequent regeneration at reduced pressures and elevated temperatures. Such conventional processes are effective in removing acid gases, but they require large energy inputs and involve several processing vessels. This paper discusses research using ion exchange membranes. It demonstrates the concept using carrier-impregnated ion exchange membranes for facilitated transport; determines the mechanisms of facilitated transport in ionomers; and models the separation process. The objectives were met using a combined experimental and modeling effort.

20786 (DOE/METC—86/6043, pp 373-385) **Pulsating gasification of low rank coals.** Zinn, B.T.; Powell, E.A. (Georgia Institute of Technology, Atlanta). Jun 1986. NTIS, PC A18/MF A01. Order Number DE86006617/JAW. (CONF-860649—). Contract AC21-84FC10620.

From 6. annual gasification contractors' meeting; Morgantown, WV, USA (24 Jun 1986).

This two year research program is concerned with the demonstration of the feasibility of gasification of low rank coals under pulsating conditions. This program will include a literature search and theoretical and experimental studies aimed at determining pulsating gasifier characteristics which will result in improved yield over conventional gasifiers. Specifically, this research program will consider the effect on the gasifier yield of such variables as the type of pulsating gasifier; the geometrical configuration of the selected gasifier; the particle loading, particle size and temperature of the feed coal; the feed gas flow rate, composition and temperature; and the frequency and amplitude of the pulsations.

20787 (DOE/METC—87/6079-Vol.2, pp 526-529) **Advanced studies of the biological conversion of synthesis gas to methane.** Clausen, E.C.; Gaddy, J.L. (Univ. of Arkansas, Fayetteville). Aug 1987. NTIS, PC A19/MF A01. Order Number DE87006496/JAW. (CONF-870659—Vol.2).

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

The technical feasibility of the biological conversion of coal synthesis gas to methane has been demonstrated in the University of Arkansas laboratories. Several microorganisms have been identified as having commercial potential for producing methane. These include a mixed culture of partially identified bacteria; P. productus, which produces acetate, a methane precursor; and Methanothrix sp., which produces methane from acetate. These cultures have been used in mixed reactors and immobilized cell reactors to achieve total CO and H_2 conversion in a retention time of less than two hours, quite good for a biological reactor. The cultures carry out the conversions at ordinary temperatures and pressures, without sulfur toxicity. This study addresses the further development of this technology through culture and reactor optimization, definition of mass transfer and kinetic parameters for scale-up and concept demonstration. Results to date are discussed.

20788 (DOE/PC/50001—45) **Advanced coal liquefaction research: Technical progress report, January 1, 1987-March 31, 1987.** Gall, W.; McIlvried, H.G. III. (Energy International, Inc., Pittsburgh, PA (USA)). May 1987. Contract AC22-82PC50001. 64p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88006399/JAW.

This report describes the work performed by Energy International during the first quarter of 1987. Most of this work involved using a larger microautoclave reactor. Studies were made of the effect of the size of the coal charge on conversion and product yield reproducibility using Powhatan No. 6 Mine and Illinois No. 6 coals. Good coal conversion and product yield reproducibility for duplicate runs were obtained after minor modifications were made to the product workup technique. The experimental program using 50°F distillate fractions of process solvent obtained from the GR and DC P-99 SRC-II PDU has been completed. Initial results indicate that all six distillates are essentially equal as hydrogen donor solvents. A sample of Wilsonville SRC deashed oil was received and distilled into two distillate fractions: 650 to 850°F. A 3 x 3 factorial design of experiments with replicates of the corner and center points (14 runs total) will be made with the 850 to 1005°F distillate cut using Illinois No. 6 coal. EI will perform the coal liquefaction runs in its 105 ml microautoclave reactor. 2 refs., 6 figs., 24 tabs.

20789 (DOE/PC/50035—T3) **Centrifugal slurry pump wear and hydraulic studies: Final technical report, October 1982 to December 1987.** Cooper, P.; Bonney, G.E.; Mistry, D.; Sloteman, D.P.; Kasztejna, P.J. (Ingersoll-Rand Co., Phillipsburg, NJ (USA). Pump Group). Dec 1987. Contract AC22-82PC50035. 280p. NTIS, PC A13. Order Number DE88003347/JAW.

In a program to improve centrifugal slurry pumps for coal liquefaction processes, hydraulic design optimization for minimum wear in these pumps was carried out experimentally and analytically. Two prototype pumps were then designed, built and run in comparative wear testing at the same head and flow conditions (approximately 300 ft and 300 gpm) against each other and against a much slower and larger, typical, commercial, state-of-the-art coal liquefaction slurry pump. The latter test involved pumps constructed of 26% chrome iron, which was confirmed to be the best material for this service. Further optimization with respect to specific speed was carried out in an accelerated wear test which compared two prototype pumps of different speeds at the same head and flow conditions. This work demonstrated that smaller, more efficient higher-specific speed centrifugal pumps can be used for future, full-scale, coal liquefaction plants - rather than those that would be specified by scaling up the pumps that were used in the coal liquefaction pilot plants. This final technical report, while covering the entire program, emphasizes the prototype testing and results of all the work. Earlier reports cover the following in more detail: (1) centrifugal pump experience in the pilot plants and (2) small-scale testing and other work that led to the design of the prototype pumps.

20790 (DOE/PC/60036—9, pp vp) **Coal beneficiation by stripping with supercritical steam.** Tu, S.T. 1985. NTIS, PC A07. Order Number DE88005597/JAW.

In Supercritical fluid extraction of coal: Technical progress report, September 1, 1985-November 30, 1985.

Water above its critical temperature can selectively remove all three forms of sulfur from coal. An apparatus was developed for treating pulverized coal particles with steam over the pressure range of 100 to 4000 psia. Effects on the extent of desulfurization of three mid-western coals were studied for four process parameters: the duration of stripping, steam pressure, temperature, and quantity of steam. Desulfurization of coal increased with increasing temperature and reaction time. Pressure and quantity of steam did not have any significant effect on desulfurization. Steam reactions with model sulfur compounds representative of the sulfur constituents in coal were investigated. Steam reactions with dibenzothiophene and diphenyl sulfide were first order with respect to the individual concentrations. Pyrite was mixed with silica to form a mineral mixture for kinetic studies. The reaction of pyrite with steam was found to follow the unreacted shrinking core model with diffusion being the rate-determining step. Based on the model compound results and correlation of experimental data, we established a kinetic model for each form of sulfur in coal. 9 figs., 13 tabs.

20791 (DOE/PC/60036—9, pp vp) **Extraction of coal with supercritical aromatic compounds and mixtures.** Haselow, J.S. 1985. NTIS, PC A07. Order Number DE88005597/JAW.

In Supercritical fluid extraction of coal: Technical progress report, September 1, 1985-November 30, 1985.

The extraction of an Illinois No. 6 bituminous coal was conducted with supercritical p-xylene and supercritical mixtures of p-xylene + 1-methylnaphthalene, or + tetralin at temperatures from 616 to 664K and pressures from 3.5 MPa to 13.8 MPa. Coal extracts were analyzed by Field Ionization Mass Spectrometry and residues were analyzed for elemental hydrogen and carbon. Correlation of net weight percent extraction data was attempted with the solubility parameter. A model for the transient dynamics of the extraction is presented. However, the model does not fit the experimental concentration profiles of the extract well. Nine equations of state were evaluated regarding their ability to describe supercritical extraction. 10 figs., 12 tabs.

20792 (DOE/PC/60036—9, pp vp) **Supercritical fluid chromotography of coal liquid compounds.** Pults, J.D. 1985. NTIS, PC A07. Order Number DE88005597/JAW.

In Supercritical fluid extraction of coal: Technical progress report, September 1, 1985-November 30, 1985.

Chromatographic data is obtained for solutes phenanthrene and pyrene using a propane mobile phase and a chemically bonded n-octadecyl stationary phase for five temperatures from T/sub r/ = 0.993 to 1.290 and seven pressures from p/sub r/ = 1.00 to 1.30. Capacity ratio and selectivity data are correlated with a model derived from thermodynamics, the accuracy of which was found to depend on the equation of state used. Previous data from van Wasen is also correlated with this model. A similarity between capacity ratio and solubility data is discussed. Resolution and efficiency are reduced assuming a Gaussian profile for the concentration distribution. 11 figs., 7 tabs.

20793 (DOE/PC/70005—9) **Sealed pressure transmission system: Final report.** Berthold, J.W.; Ghering, W.L. (Babcock and Wilcox Co., Alliance, OH (USA). Research and Development Div.). Sep 1987. Contract AC22-85PC70005. 75p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88003511/JAW.

A comprehensive program was developed and carried out by the Babcock & Wilcox Company (B & W) for the design, fabrication, and testing of both pressure and differential pressure transducers that will operate reliably, accurately, and safely at process operating conditions of 3280 psi and 800°F. All of the development work was performed at the B & W Research and Development Division. The program included the following tasks: project work plan, survey of past experience, and preliminary design; detailed design; and construction, fabrication, and laboratory testing. The field testing was conducted at the Stearns-Catalytic, Inc., coal liquefaction pilot plant located in Wilsonville, Alabama. This report documents the successful development, testing, and evaluation of sealed pressure transmission systems for high-temperature, high-pressure applications such as coal liquefaction. 4 refs., 24 figs., 2 tabs.

20794 (EPRI-AP—5460-SR) **Proceedings: Twelfth annual EPRI contractors' conference on fuel science and conversion.** Lebowitz, H.E. (Electric Power Research Inst., Palo Alto, CA (USA)). Feb 1988. 439p. (CONF-8705261—). Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920202/JAW.

From 12. annual EPRI contractors' conference on fuel science and conversion; Palo Alto, CA, USA (13 May 1987).

EPRI's Twelfth Annual Contractors' Conference on Fuel Science and Conversion was held on May 13 and 14, 1987, in Palo Alto, California. The conference featured results of work on coal science coal liquefaction, methanol production, coal oil coprocessing and coal upgrading. Eighteen papers have been cataloged individually.

20795 (EUR—10567, pp 1157-1172) **Coatings for the protection of low-alloy and carbon steels against corrosive attack in waste heat recovery systems of coal gasifiers.** Baxter, D.J. (Argonne National Laboratory, IL (USA). Material Science and Technology Division). 1986. D. Reidel Publishing Company, Dordrecht, Netherlands. (CONF-861025—).

From 3. conference on high temperature alloys for gas turbines and other applications; Liege, Belgium (6 Oct 1986).

The poor corrosion resistance of low-alloy, boiler-grade steels at the temperature of future coal gasifier waste heat recovery systems (typically exceeding 400 degrees C) and the relatively high cost of austenitic stainless steels necessitate the development and evaluation of protective coatings for low-alloy steels. Only coatings that could be applied to large components were used for the experimental investigation. Pack-diffusion aluminized, chromized, and aluminized/chromized coatings with various chemical compositions and microstructures and furnace-fused FeCrAl and CoCrAl coatings were exposed to simulated medium-Btu coal gasifier environments under both isothermal and thermal cycling conditions. Four welding alloys on aluminized substrates were also evaluated. Minimum Al and Cr contents of 14-20 wt% and 18-22 wt%, respectively, were required to support protective oxidation behavior under isothermal conditions, although the presence of defects, particularly cracks, in aluminized and furnace- fused FeCrAl and CoCrAl coatings can promote severe internal degradation. In some cases, thermal cycling promoted sulfidation attack. All welding alloys exhibited high rates of corrosive degradation. 12 refs., 5 figs., 3 tabs.

20796 (EUR—10567, pp 1305-1309) **Corrosion in simulated coal gasification atmospheres and its effect on creep behaviour.** Davidson, J.H.; Beranger, G.; Armanet, F.; Tachikart, M.; Cayla, O.; Sannier, J.; Fauvet, P.; Lefort, A.; Silvestre, G. 1986. D. Reidel Publishing Company, Dordrecht, Netherlands. (CONF-861025—).

From 3. conference on high temperature alloys for gas turbines and other applications; Liege, Belgium (6 Oct 1986).

A number of candidate materials for coal conversion applications, including both existing commercial grades and developmental alloys, have been tested in simulated gasification atmospheres. Parameters investigated included the effect of gas composition, temperature and pressure on the corrosion behaviour, and the interaction between corrosion and creep. The paper describes the results obtained in the course of an on-going collaborative research program, involving five different laboratories. 5 refs., 8 figs., 4 tabs.

20797 (EUR—10567, pp 245-268) **Materials behaviour in coal gasification environments.** Grabke, H.J.; Norton, J.F.; Casteels, F.G. (Max-Planck-Inst. fuer Eisenforschung, Duesseldorf (Germany, F.R.)). 1986. D. Reidel Publishing Company, Dordrecht, Netherlands. (CONF-861025—).

From 3. conference on high temperature alloys for gas turbines and other applications; Liege, Belgium (6 Oct 1986).

The coal gasification processes and types of gasifiers are briefly outlined and the need of metallic materials is put forward, especially for the raw gas heat exchanger. The present paper reports investigations with Fe-32Ni-20Cr, Fe-25Cr-20Ni and similar materials up to 800 C. The effects have been studied of varying the values of pS_2, pO_2, and temperature, as well as the effects of preoxidation and of alloying the standard materials with additional elements. The mechanisms have been elucidated and are described for the transient stage of simultaneous oxidation/sulfidation and for the external and internal growth of sulfides on and beneath the oxide scale. Recommendations are derived from these studies concerning the performance of the technical process. For the start of operation it is recommended to keep the sulfur pressure as low as possible in order to obtain a protective oxide layer on the metallic components, or even to apply a pre-oxidation under certain controlled conditions. Concerning alloying measures, additions of 2-4% Al were found to be very favourable for sulfidation resistance and about 0.1%Ce improves the scale adherence. The manganese content of the alloys should be low, to suppress the external sulfidation. By the application of these guidelines long-term sulfidation resistance can be achieved at elevated temperatures up to about 800 C. 59 refs., 9 figs.

20798 (NEDO-OS—8604) **FY 1985 annual report. Coal conversion technology.** (New Energy Development Organization, Tokyo (Japan)). Apr 1986. 231p. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88770064/JAW.

This paper reports the development of coal liquefaction and gasification technologies in FY1985. Small scale and basic experiments of three processes of bituminous coal liquefaction were carried out. The studies on the catalyst for liquefaction, catalyst for hydrogenation of liquefied oil, deashing of coal and reforming of liquefied oil were made at the same time. A 250 t/d-pilot plant of NEDOL process derived from the integration of the three processes was designed based on these findings. A 50 t/d-brown coal liquefaction pilot plant was designed and it was constructed in Australia and operated. The technologies of the components such as the material for reactor and subsystem and the materials were investigated. The 7000 Nm^3/d-high calorie gas producing pilot plant equipped with the fluidized-bed gasifier was operated. The entrained flow gasifier and the refractories and ceramics for slagging furnace were studied. (59 figs, 20 tabs)

20799 **(NEDO-P—8508) Study on feasibility of coal liquids as feedstock and their technical development (Part 2).** (New Energy Development Organization, Tokyo (Japan)). Mar 1986. 132p. (In Japanese). NTIS (US Sales Only), PC A07. Order Number DE88770060/JAW.

The content, separating technique and application of polycyclic aromatic compounds contained in coal liquids were investigated. It is estimated that several hundreds thousands tons per year each of the polycyclic aromatic compounds such as naphthalene, acenaphthene, anthracene and phenanthrene will be able to be produced in a commercialized coal liquefaction plant. Most of the polycyclic aromatic compounds are derived from coal tar at present. The applications of polycyclic aromatic compounds including naphthalene were examined. The separative purification methods such as distillation, chromatography, adduct, pressure crystallization and supercritical gas-extraction were examined. The reactions of polycyclic aromatic compounds such as hydrogenation, carbonization and polymerization were studied. The separation and application technology of heterocyclic compounds described in the appendix of the report of the last fiscal year were reviewed. The contents of polycyclic aromatic compounds in coal liquids are so high and the chemical structures are so much characteristic that the use of them as the feedstock and their effective utilization are feasible. (73 figs, 40 tabs, 249 refs)

20800 **(NEDO-P—8509) Feasibility study on application of petroleum refining technology to coal liquefaction.** (New Energy Development Organization, Tokyo (Japan)). Mar 1986. 98p. (In Japanese). NTIS (US Sales Only), PC A05. Order Number DE88770061/JAW.

The technology on the catalyst for petroleum refining has been almost established. Although the catalysts for hydrogenerative refining of the residual oil have a problem in the deterioration of catalyst, the catalysts nowadays resist the severe conditions. As for the catalyst for coal liquefaction, iron catalysts for the direct liquefaction of coal have been studied since prewar days and iron sulphide is appropriate for the catalyst. Homogeneous transition-metal complex catalyst has high-hydrogenation power. Using a hydrogen donor solvent, the catalyst plays an important role in the latter stage of liquefaction of coal. Molybdenum shows higher conversion rate of asphalten than iron in the liquefaction of coal. The distillate purification processes of Mobile, UOP and Chevron were examined. The deterioration problem of catalyst by catalytic poison in the hydrocracking of the residual oil is being studied. The reaction mechanism of and the catalyst for removing the heterocyclic compounds from coal liquids were investigated. The utilization of carbons derived from the thermal cracking of coal and coking of coal liquids is described. (48 figs, 45 tabs, 183 refs)

20801 **(NEDO-P—8511) Feasibility study on fuel cell power generation system using coal gas.** (New Energy Development Organization, Tokyo (Japan)). Mar 1986. 90p. (In Japanese). NTIS (US Sales Only), PC A05. Order Number DE88770056/JAW.

The application of coal gas to the fuel cell technology was technically investigated. The purpose of the study is to help the investigation on what the fuel cell power generation system should be in future. The items of the study in FY1985 include basic specifications of power generating plant and of fuel cell, coal gasification system and the total fuel cell system using coal gasification. Although the molten carbonate fuel cell is considered promising as the fuel cell incorporated in the coal gasification, the phosphoric-acid fuel cell extremely approaching the commercialization was also examined for comparison. The operating temperature of solid electrolyte fuel cell is as high as approximately 1000°C and the whole efficiency including the recovery of waste heat is regarded as the highest among those of the fuel cells. The development of this type of fuel cell is, however, now in the laboratory stage yet. It will be continuously investigated in our subjects. (10 figs, 40 tabs)

20802 **(NEDO-P—8607) Feasibility study on application of petroleum refining technology to coal liquefaction (Part 2).** (New Energy Development Organization, Tokyo (Japan)). Mar 1987. 121p. (In Japanese). NTIS (US Sales Only), PC A06. Order Number DE88770066/JAW.

The trends of development of catalyst in the field of purification of coal liquids in Japan and abroad were surveyed and the application of the conventional petroleum purification technology to the treating process of coal liquids was investigated. The following items in the first stage liquefaction of coal were examined: the effect on the improvement of yield of coal liquids and on the catalyst; the possibility of application of FCC process to the coal liquids; the possibility of blending the coal liquids with petroleum product and their purification reaction; the structure of heterocyclic compounds and their purification reaction; the correlation of the structure of heterocyclic compounds with the reactivity; and the role of catalytic function in the elimination of these compounds. The following items in the second hydrogenation of coal liquids were examined the mechanism of deterioration of catalyst caused by the depositions of carbonaceous substance and metal ions and its countermeasures; incineration of carbonaceous substance for regenerating the catalyst; melting of the ash of metal; and the present situation of the recovery methods of metal remaining in catalyst. The results indicate that all the knowledge required for the operation of the processes which are being planned at present has been accumulated. (65 figs, 72 tabs, 195 refs)

20803 **(NEDO-P—8620) Feasibility study of coal liquids as feedstock and their technical development (Part 3).** (New Energy Development Organization, Tokyo (Japan)). Mar 1987. 143p. (In Japanese). NTIS (US Sales Only), PC A07. Order Number DE88770067/JAW.

Firstly, the composition, separation and effective utilization of paraffins contained in coal liquids were examined. Although the separation technology of n-paraffins in petroleum refining includes four processes, these processes have never been applied to coal liquids. n-paraffin has promising uses such as surface active agent, feedstock for synthetic detergent, 6-nylon and perfume. Secondly, the compounds were examined. Three processes used in the tar industry are expected as the separation method for the compounds. The supercritical gas-extraction technique is also feasible. The polycyclic aromatic compounds have promising uses such as fine chemicals, high-molecular weight liquid crystal, photosensitizer and carbon material. Thirdly, the separation and utilization of heterocyclic compounds and bicyclic or less aromatic compounds in coal liquids were examined. The alkali extraction method was presented for separating phenols. The uses include the synthesis of monomer for high-functional resin, feedstock for pharmaceuticals and pesticides, and liquid crystal compounds. The dealkylation and oxidation of those compounds were investigated. (67 figs, 62 tabs, 1 photo, 288 refs)

20804 **(NEDO-P—8622) Feasibility study on fuel cell power generation system using coal gas (Part 2).** (New Energy Development Organization, Tokyo (Japan)). Mar 1987. 346p. (In Japanese). NTIS (US Sales Only), PC A15. Order Number DE88770069/JAW.

Although the molten carbonate fuel cell (MCFC) is most promising among the fuel cells incorporated in coal gasification, the phosphoric acid fuel cell (FAFC) regarded as approaching commercialization was also examined. In FY 1985, the basic specifications of power generation plant and fuel cell, and the total system were examined and investigated. In FY 1986, the constitution of total system, specifications of main components, predicted performance of plant, heat and material balances, control method of plant and lay-out were examined and investigated. The examined result indicates that comparing the performances of fuel cell generation plants using coal gas with each other, the net thermal efficiency of PAFC type is 36.0%, while that of MCFC type is 50.7%. It is proven, therefore, that the MCFC is superior to the other fuel cell power generation systems using coal gas. The present technical level and simple survey of system of the solid electrolyte fuel cell are only presented in this paper. (71 figs, 117 tabs)

20805 (NEDOJ—8401, pp 7-11) **Development of bituminous coal liquefaction. Study on direct hydrogenation using 2.4t/d plant.** Aug 1984. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770050/JAW.

In FY 1983 NEDO Annual Report.

This is the 1983 annual report of the entitled research. Research was made for the prolonged operation of a 2.4 t/d coal liquefaction plant and for grasping the material balance through the medium oil circulation operation. With regard to RUN-400, which

was operated first, Wandoan coal was reacted using catalyst of red mud and sulfur at about 440°C and 250 atm. Concequently 240 hours of continuous coal liquefaction operation and 248 hours of continuous maintenance of high temperature and high pressure were achieved. After such modifications basing on the results of the above experiment as alteration of the circulating gas heating device, installation of a residue recovering device, RUN-500 was made. This operation was done with synthetic iron catalyst at 420-450°C and 250 atm, achieving such good results as 471 hours of continuous coal liquefaction operation and 560 hours under high temperature and high pressure. Furthermore the distillation system was modified in order to research exactly the material balance. (1 tab)

20806 (NEDOJ—8401, pp 12-32) **Development of bituminous coal liquefaction. Study on direct hydrogenation using bench-scale apparatus.** Aug 1984. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770050/JAW.

In FY 1983 NEDO Annual Report.

This is the 1983 annual report of the entitled research. (1) As a part of the liquefaction experiment by liquid autoclave, an experiment of liquefaction reaction was performed using a complete mixing tank and a reaction model was formulated. Also in order to get the physical conditions within the reactor, average holding hours of the liquid state, composition of the liquid state, composition of the gaseous state and density of the liquid state in the reactor were directly measured and its results were applied to the reaction model. Furthermore taking notice of the composition of medium oil, a simulation of cold flow was made. Then the reaction model of Wandoan coal was applied to the continuous experiment apparatus of 0.1t/d and the estimated value coincided well with the experimental value. (2) A continuous experimental operation of the 0.1t/d apparatus using Wandoan coal was executed with the circulation of medium oil. As the results, progresses were made on the following subjects; possibility of reduction of reaction pressure, relationship between medium oil and liquefaction characteristics, comparison of catalysts performances, relationship between the kind of coal and liquefaction characteristics, computation of the rate between actual and estimated values by the multiple recurrence analysis method and equilibrium relationship of gas and liquid under the circumstances of high temperature and high pressure. (17 figs, 1 tab)

20807 (NEDOJ—8401, pp 36-42) **Development of bituminous coal liquefaction. Study on direct hydrogenation with iron catalyst and catalyst reutilization using small size apparatus.** Aug 1984. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770050/JAW.

In FY 1983 NEDO Annual Report.

This is the 1983 annual report of the entitled project. (1) Through an experiment of reaction using iron catalyst as the catalyst for direct hydrogeneration of coal, it was revealed that when medium oil is switched from anthracene oil to equilibrium medium oil, superiority of activity of manufactured catalyst is reduced, but viscosity of liquefaction oil remains always lower than other catalysts. Besides in case of liquefaction of more carboniferous coal, much soluble hexane is formed. Furthermore it was learned that a prereactor treatment suppresses excessive decomposition reaction and makes transformation to oil more cost efficient. (2) In order to study methods of recycling catalyst in the neighborhood of the reaction process, recovery rates of catalyst etc. were measured by various liquid-cyclone type catalyst separation apparatus. In addition the manufacturing method of high hardness granulating catalyst separator was improved and the prototype of manufactured catalyst, which fulfills almost all the conditions of activity, diameter of grain, and strength, was acceptably established. (1 fig)

20808 (NEDOJ—8401, pp 43-45) **Development of bituminous coal liquefaction. Study on direct hydrogenation and relation between coal property and liquefaction characteristics using small size apparatus.** Aug 1984. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770050/JAW.

In FY 1983 NEDO Annual Report.

This is the 1983 annual report of the entitled project. Through the relationship between liquefaction tests using autoclave and distribution of reflection indexes of coal, the kinds of coal which are considered to have good liquefaction characteristics were selected from among coal samples from Canada, USA and Australia. Besides the changes of liquefaction characteristics due to circulation of medium oil were investigated about these samples. Furthermore in order to examine the changes of the property of coal slurry during the stage of raising temperature in the direct hydrogenation liquefaction process, a basic experiment apparatus for preheater was assembled. For the purpose of elucidating the coking phenomenon using the above apparatus, a heated test operation with 20% slurry of Taiheiyo coal was made. (1 fig)

20809 (NEDOJ—8401, pp 46-54) **Development of bituminous coal liquefaction. Study on solvent extraction process using 1 t/d plant.** Aug 1984. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770050/JAW.

In FY 1983 NEDO Annual Report.

This is the 1983 annual report of the entitled project. Seven runs of a t/d plant were made using pitch coal as raw material and the annual slurry operation hours reached 1,485h in total. During the above operations, the following works were performed; a) Study of liquefaction conditions, b) Completion of an apparatus capable to discharge out of the system solid material which is accumulated in the liquefaction reaction tower, c) Improvement of the performance of a bottom circulation pump, d) Solution of the problems of leakage from and blockage of the high pressure system, e) Preparation of the standardized form for assessing reaction results. Equipment and apparatuses were fully inspected. Such big problematical points as progress of corrosion, etc., however, were not discovered. An engineering study of a large plant was made with reference to the data of the 1 t/d plant; namely computation of the conditions of mixed stage liquid around the reaction tower, estimation of the conditions of solid particles in the reaction tower and presumption of temperature distribution in the tower, presumption of fluidity pressure loss and temperature distribution etc. in the slurry heating pipes, computation of temperature distribution, fa distribution and tower pressure loss of solvent hydrogenation reaction tower, and grasp of wearing conditions of valves. (1 tab)

20810 (NEDOJ—8401, pp 55-58) **Development of bituminous coal liquefaction. Study on solvent extraction process using small size apparatus.** Aug 1984. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770050/JAW.

In FY 1983 NEDO Annual Report.

This research was performed as one of the studies funded by NEDO. The study is intended to improve the process by performing the studies on a solvent extraction liquefaction process by using a continuous extraction unit, a continuous hydrogenating unit, batch type reaction system. And as a back up research for the plant development of the solvent extraction liquefaction process, an operation was carried out on the small scale extraction unit, and the continuous hydrogenating unit in order to establish optimum conditions. As a result, to improve the yield using a CGS catalyst for the continuous extraction unit and the continuous hydrogenating unit, an effect on reacting pressure, reacting time and addition of catalyst was observed. It was found that the liquefaction yield of 50% dry coal would be secured at the reaction temperature of 450°C, reaction pressure of 190 kg/cm^2, reaction time of 60 min. And on the batch type reaction system, it was confirmed that feed rate ratio of carbon and oxygen was an important factor.

20811 (NEDOJ—8401, pp 59-65) **Development of bituminous coal liquefaction. Study on separation of solid and liquid in solvent extraction process.** Aug 1984. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770050/JAW.

In FY 1983 NEDO Annual Report.

This research was performed as one of the studies funded by NEDO. The study is intended to establish the effective systematization technology of solid/liquid separation process to develop a coal liquefaction plant by a solvent extraction process. In order to confirm and prove the effects of various measures against the problems of centrifugal separation unit, a continuous operation for 700 hours was performed. And the measures taken on structure and material were found effective. Using samples of liquefied coal produced by the 1 t/d test plant installed at Sumitomo Metal Industries, a recovery test for the useful component by a centrifugal separator was

performed and the recovery rate for each component was clarified for various operating conditions. It was, also, verified that naphtha is an excellent recovery medium for the heptane solubles and asphaltene in the bottom oils. (7 figs)

20812 (NEDOJ—8401, pp 66-76) **Development of bituminous coal liquefaction. Study on solvent hydrogenation in solvent extraction process.** Aug 1984. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770050/JAW.

In FY 1983 NEDO Annual Report.

This research was performed as one of the studies funded by NEDO. The study is intended to develop an efficient coal liquefaction process based on a solvent extraction process and obtain basic data required for the design of a large scale pilot plant for the bituminous coal. In order to select a coal suited for the application of the solvolysis process, an evaluation was conduoted for 8 species of coal from Australia and U.S. It is concluded that the U.S. coal was superior to the conventional Australian bituminous coal in the liquefaction reactivity on account of the higher sulfur content. By adjusting a circulation model aiming at the consumption, regeneration and variation characteristics of the hydrogen-giving solvent, the simulation proved the capability to forecast the result of the circulating operation of the continuous plant with a good accuracy. (1 figs, 2 tabs)

20813 (NEDOJ—8401, pp 77-81) **Development of bituminous coal liquefaction. Study on solvolysis liquefaction process.** Aug 1984. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770050/JAW.

In FY 1983 NEDO Annual Report.

This research was performed as one of the studies funded by NEDO. The study is intended to establish a systematization technology on the solvolysis pitch hydrogenating process as one of themes required for the plant development by the solvolysis liquefaction process for the bituminous coal. A study on the selection of hydrogenating conditions was carried out and, the reactivity of the hydrogenation catalyst was evaluated while comparative durability tests were performed on a self-developed catalyst using alumina-titania as a carrier to be compared with Shell-324. However, in despite of the improvement, in regard to the strength, the self-made catalyst was found only half as strong as compared to Shell-324. It was also clarified that further improvement was required for the self-made catalyst on the abrasion resistance. Besides, a review on testing conditions for an autoclave was carried out, capable of evaluating the high SRC cracking characteristic and the regeneration of a high quality liquefaction solvent.

20814 (NEDOJ—8401, pp 82-84) **Development of bituminous coal liquefaction. Basic design of pilot plant.** Aug 1984. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770050/JAW.

In FY 1983 NEDO Annual Report.

This research was performed as one of the studies funded by NEDO. The study is intended to perform a conceptual design of pilot plants for the three systems of the bituminous coal liquefaction plants, and evaluate the result of the above study and the operation research of the test plant. The pilot plant must have the following characteristics: (1) Under a comparatively moderate reacting condition, the process must produce a product containing more amount of light distillates while giving a higher liquid yield. (2) The process must consist of reliable elementary processes with high safety features. (3) A wide application ranging from a sub-bituminous coal to a bituminous coal with a low degree of carbonization must be feasible. And in order to attain these objectives, following technological targets were set up: (1) A continuous operation of over 1,000 hours is feasible under a reacting condition of 430 - 460°C, 150 - 200 kg/cm^2, a liquid yield of over 50%, an average load rate of over 90%. (2) A processing capacity of over 225 t dry coal/day is feasible using a coal with an ash content of less than 10% and the oxygen content of 10 - 20%.

20815 (NEDOJ—8401, pp 85-92) **Development of brown coal liquefaction. Study on an optimum liquefaction process.** Aug 1984. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770050/JAW.

In FY 1983 NEDO Annual Report.

This research was performed as one of the studies funded by NEDO. The study is intended to obtain the operation and also design data required for a pilot plant with a capacity of 50 ton/day to be built for the liquefaction of the brown coal at Victoria, Australia. The research was performed centering on the element study by PDU and others and the following results were obtained. (1) Study on the hydrogenating technology: Under a condition where the CLB was recycled by 50 wt.% per maf of brown coal, it was found that no serious problem broke out in particular when the ratio of solvent/brown coal was 3.0. (2) Study on deashing technology: Using a batch type unit, conditions capable of removing the ash and preasphaltene content (benzene insoluble - pyridine soluble) all at once were selected, and by means of the continuous deashing operation, the complete removal of preasphaltene content was confirmed. (3) Study on the secondary hydrogenation: The relation of the quantity and quality of preasphaltene to the catalyst deterioration and the effect of the guard reactor was studied.

20816 (NEDOJ—8401, pp 93-107) **Development of brown coal liquefaction. Design, construction and operation of 50 t/d pilot plant.** Aug 1984. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770050/JAW.

In FY 1983 NEDO Annual Report.

This research was performed as one of the studies funded by NEDO. The study is intended to design, build and operate a 50 ton/day pilot plant required for the liquefaction of the brown coal at Victoria, Australia. In this study, a detailed design for the primary hydrogenation system was carried out as a first step being followed by the manufacture of the mechanical equipment belonging to the same system. Then the dehydrating, deashing and secondary hydrogenating systems were designed and manufactured. Consequently, the construction work on the spot, the preparation for the operation and the supporting work were carried out. In this case, the machinery equipment for the pilot plant was so arranged as to be procured in the two countries, Japan and Australia. for items to be procured in Australia, Davy Mackee Pacific Limited was employed. The Company was requested to undertake a portion of the detailed design, the work design and the procurement and service in Australia. As regards the inspection of pressure vessels to be procured outside Australia, it was so determined as to be performed by a third party organization authorized by the Labor Department of Victoria as their agent.

20817 (NEDOJ—8401, pp 108-113) **Trial fabrication and development of machinery and material for coal liquefaction plant (chemical reactors).** Aug 1984. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770050/JAW.

In FY 1983 NEDO Annual Report.

This research was performed as one of the studies funded by NEDO. The study is intended to develop the reactor material and auxiliary machinery material required for the commercialization of the liquefaction plant. And the outline of the study result is as follows: 1. Development of reactor material; Using a forged shell manufactured for the test purpose, having a thickness of 400 mm (using a 80 ton ingot) and another shell with the thickness of 450 mm (using a 250 ton ingot) as objectives, high temperature strength data on the original material and the welded part were collected. Then by computing the design stress, a value exceeding the conventional 3 Cr - 1 Mo steel by about 35% was obtained at 482°C. On hydrogen erosion, a long time exposure test was carried out at the hydrogen pressure of 300 kg/cm^2, and the data were collected up to 10^4 hr. However, no material deterioration was observed. 2. Development of auxiliary material; A test piece procured in the previous fiscal year was set in the 24 t/d test plant for an in-plant test through the two coal liquefaction operations. After each coal liquefaction operation, the installation was overhauled for inspection and the test pieces were checked for an erosion and erosion - corrosion test. (1 fig)

20818 (NEDOJ—8401, pp 114-116) **Trial fabrication and development of machinery and material for coal liquefaction plant (machinery and auxiliaries).** Aug 1984. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770050/JAW.

In FY 1983 NEDO Annual Report.

This research was performed as one of the studies funded by NEDO. The study is intended to grasp the damage behavior of the material used in various parts of the system of the liquefaction plant so that the optimum material will be selected for a large scale pilot plant. The outline of the study result is as follows: (1) In-plant material test for 1 ton/day test plant: A study was performed by partially taking out in 1983 the test pieces inserted during 1982. With the low-alloy steel, corrosion was found as most severe at the liquefaction column whereas on the stainless steel, the maximum corrosion was found at the top of the liquefaction high temperature separation column. (2) Basic corrosion test: As a result it was clarified that the corrosion speed decreased as the slurry concentration increased. (3) Basic anti-corrosion test in the condensed liquid: Using the autoclave produced, a 500 hr. test was carried out in the water of high temperature and pressure. The test showed no cracks resulted from the stress corrosion for an alloy such as alloy 800.

20819 (NEDOJ—8401, pp 117-127) **Trial fabrication and development of hydro-hoist for coal liquefaction plants.** Aug 1984. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770050/JAW.

In FY 1983 NEDO Annual Report.

This research was performed as one of the studies funded by NEDO. The study is intended for the development of a hydrohoist with a good reliability required for the supply of the feed stock for a large scale pilot plant for the NEDO coal liquefaction process (NEDOL process). In order to produce the elements of the hydrohoist for the coal liquefaction plant the test equipments including valves, a feed chamber, pressure balancing system, and a float as element machineries were designed and manufactured. The study has been performed continuously since the fiscal year 1980, and in 1983, a study on the hydrohoist system for the feed stock slurry supply in a coal liquefaction plant and the operation system was carried out for the 250 t/d pilot plant. A test unit was also manufactured. It is scheduled to perform the reliability test using the above units in 1984 and 1986. (2 figs, 1 tab)

20820 (NEDOJ—8401, pp 128-131) **Development of centrifugal slurry pump for coal liquefaction plants.** Aug 1984. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770050/JAW.

In FY 1983 NEDO Annual Report.

As a result of studies made in 1982 on centrifugal slurry pumps for liquefaction plant, development of pumps became promising. To demonstrate the effect of the studies, pumps and facilities for the examination of elemental technology were designed and constructed. (1 tab)

20821 (NEDOJ—8401, pp 132-134) **Investigation of coals for coal liquefaction.** Aug 1984. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770050/JAW.

In FY 1983 NEDO Annual Report.

Liquefaction tests of coal were performed for various kinds of coals (10 Canadian coals, 4 Australian coals) to see the relation between coal quality and liquefaction characteristics, and the following results were obtained. (1) Liquefaction test on Canadian Coals; 2 kinds of bituminous coals, 6 kinds of subbituminous coals, and 2 kinds of brown coals were subjected to liquefaction tests using iron and sulfur as catalysts, and studied for their hydrogen consumption, amounts of gas production, oil yields, asphalten yields, conversion rate of benzine, conversion rate of tetrahydrofuran, etc. (2) Relation of coal properties and liquefaction characteristics of Canadian coals: Conversion rates of both benzine and tetrahydrofuran decreased slowly with the increase in the degree of coalification, and had a tendency of sudden decrease at each of the specific points. With subbitumious coals, vitrinite reflaction rate was affected particularly by volatile matters, heating values, and carbon contents, and the inertinite contents and liquid yields showed good relationship. As the result, liquefaction characteristics seem to be estimated by overlapping coalification degree and petrographical constituent with the combination diagram of volatile matters, calorific values, and carbon contents made as the basis.

20822 (NEDOJ—8401, pp 135-137) **Investigation of coals for coal liquefaction. Study on Chinese coals.** Aug 1984. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770050/JAW.

In FY 1983 NEDO Annual Report.

This is the annual report for 1983 regarding the liquefaction study on Chinese coals which started in 1980. The study has been jointly made with the China Coal Science Research Institute. In 1983, four operations were performed on the small size continuous test facility which was completed in 1982 to study liquefaction charactersistics of Hokushoku coal, capacity of the facility, and to train Chinese researchers in the opertional technique. (1 tab)

20823 (NEDOJ—8401, pp 138-141) **Study on selection of coals for liquefaction. Refining and uses of coal liquids.** Aug 1984. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770050/JAW.

In FY 1983 NEDO Annual Report.

This is the annual report for 1983 on the study being made from 1980. In 1983, based on the analytical and testing methods established in 1982 for coal liquid, analyses and tests were made on 24 items for two kinds of sample oils (A: 1 t/d PDU liquid oil; B: 2.4 t/d PDU liquid oit), and the following results were reached: a) Properties of A sample oil; The gasoline fraction was rich with saturated hydrocarbon, the light oil fraction was rich in aromatics, less nitrogen for lighter fractions, and the sulphur content was about 0.1%. It contained much hydrogen but little remaining carbon. Mercaptan occupied most part of the sulphur, and isopropyl mercaptan and 2-butyl mercaptan occupied one third of the total sulphur. 28% of the total nitrogen was pyridine and 25% was nitrile. As the result of the analysis of the colored materials produced during the storage of the A sample oil revealed that the nitrogenated compounds played an important role in the coloring reaction. b) Properties of B sample oil; It was found that the oil contained somewhat less hydrogen, and tended to have higher aromaticity.

20824 (NEDOJ—8401, pp 142-150) **Development of application of estimation method for the coal liquefaction process. Development of liquefaction process simulator.** Aug 1984. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770050/JAW.

In FY 1983 NEDO Annual Report.

This is the annual report for 1983 concerning the study started in 1981. In 1983, for the development of software for liquefaction simulators, tests were made with priority given to detailed design of simulators, production of programs/unit tests. In addition, basic design for areas related with liquefaction reaction process and some combination tests were carried out. a) Development of software for liquefaction simulator: Basic design of programs concerning liquefaction process was made. Further, detailed specifications for the simulator (each of the processing functions, interfaces, etc.) were also determined. b) System analysis for the establishment of detailed technique: As regards the method for estimating physical properties of liquefied oil, modifications such as reviewing parameters of functional groups of aromatic rings and naphthene rings were made. c) Development of models for liquefaction and solvent hydrogenation: In connection with the gas production yields of inorganic gases (CO_2, NH_3, H_2S, etc.) and hydrocarbon gases, relationship was studied with the amount of hydrogen consumption and elemental composition of coal made as the parameters.

20825 (NEDOJ—8401, pp 151-152) **Development of environmental protection technology. Development of coal liquefaction waste water treatment.** Aug 1984. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770050/JAW.

In FY 1983 NEDO annual report.

As for the final objects of the 1983 project to establish the stable and economical processing methods for the waste water from coal liquefaction plants and to research how the total system of coal liquefaction processes including waste water processing should be, investigations of the quantity and quality of the waste water were made and the experimental apparatuses for waste water processing were manufactured. The results are as follows. 1. As for the developments of unit operations for highly effective waste water

processing, experimental apparatuses were manufactured. (1) Dephenol method of energy saving type (impregnated membrane method), (2) Highly effective biological processing method (anaerobic bacteria fluid bed method), and (3) Waste water batch processing without biological processing (contact wet oxidation method). 2. Concerning the research and development for a total waste processing system of liquefaction plants, liquefaction processes for reducing waste water processing load were investgated and the quantities of the water as well as the produced oil in contact with the water concerned was measured, 8 kinds of simulated waste water were prepared by mixing produced oil and water, and the qualities of these waste waters were analyzed.

20826 (NEDOJ—8401, pp 153-159) **Development of coal gasification. Study on production of high calorie gas, using 7000 Nm³/d plant.** Aug 1984. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770050/JAW.

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As for the object of the 1983 project, to develop a high calorie gasification plant capable of 7000 Nm³/d, using the fluidized bed method, a plant was operated by the method of gasification of pressurized fluid raw materials of a hybrid of coal and heavy quality oil. The results are as follows. As for the most suitable conditions of gasification for the increase of efficiency, gasification tests of 30 Kg/cm²G slurry were done. (1). The feasibility of the operation using two slurry nozzles was established and the increase of efficiency by the high temperature rise of the thermal dissolution section in the gasification furnace was expected. (2). By making slurry nozzle tips of ceramic, decreasing atomized steam, and raising temperature of thermal dissolution section higher, the growth of deposit at the wall facing against the nozzles was prevented, the quantity of HTL coking was decreased and the efficiency of gasification was increased. (3) The long term operation with use of multi-stage oxygen blowing was made. By the increase of oxygen quantity in the mid-stage of the furnace, the temperature difference between the upper side and lower side of the fluid layer was decreased, the temperature of the heat dissolving section approached to 900°C and the efficiency of gasification reached 70% (2 figs, 1 tab)

20827 (NEDOJ—8401, pp 160-168) **Development of production technology of high calorie gas. Trial use of equipments for pressurized and fluidized gasification plants using mixed materials of coal and heavy fraction oil.** Aug 1984. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770050/JAW.

In FY 1983 NEDO Annual report.

As for the object of the 1983 project to obtain the technical feasibility of the reduction of quantity of steam, the following items were studied. 1. Concerning the pressurized fluid gasification of raw materials mixed with coal and heavy quality oil, (1) With use of the gasification method by two staged oxygen blowing, temperature of the slurry spraying area was raised high and the gasification efficiency was improved. (2) Gasification with the shortened furnace diameter was tested, the quantity of steam was reduced to 1/2 of the volume as used to be and gasification performance was elucidated and the guideline to higher efficiency was obtained. 2. As the developments of the material for plant equipment, (1) Through tests and studies of corrosion to be carred by high temperature and high pressure gas, the effects of the process factors to material corrosion, caused by the quantity of steam and density of H_2S, were resolved. (2) Through tests and studies of material abrasion due to high temperature fine particles, the effects of environmental factors of the materials to particle abrasion were elucidated. (3) With use of the 7000 Nm³/d plant, materials were tested and the damaged materials were investigated, and the conditions of corrosion and damage of the alloys under the actual process environments were clarified. (4) New heat resistive and anticorrosive alloys were produced experimentally and evaluated, and the effectiveness of Al addition was established. By these studies fundamental guide lines for the development of materials and its feasibility were firmly established. (2 figs)

20828 (NEDOJ—8401, pp 169-176) **Development of production technology of high calorie gas. Element studies for multi-purpose high temperature gasfication.** Aug 1984. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770050/JAW.

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As for the object of the 1983 project to design manufacture and tomake test runson cold model of the same scale to the PDU and to obtain the general conception of burner test equipment, the following results of development were obtained. 1. Concerning the study of the shape of the furnace, the fundamental specifications of the multi-purpose high temperature gasification furnace PDU were investigated and determined to the effect that the scale be 20-50 t/d the maximum gasifying pressure be 3 MPa and the diameter be 0.7 m in order to achieve the proper structure of the PDU frunace. In accordance with these specifications a cold model was constructed. As for the test items, the measurement of gas flow governing the behavior of coal particles, and the measurement of coal particles flow relating with coal reacting time in the furnace, were selected and performed with different angles and heights etc. at which the burner nozzles are set, the velocities of gas and particles, etc. were measured and the basic data for the selection of furnace shape and the analysis of flow, were obtained. 2. As for the investigation of coal burners, the pressurized jet layers of coal burner were investigated and evaluated and the basic data were compiled. As the results the cooling method and cooling structure of the burner, the shape and materials of the tip of the burner, the burner fixing method to the body of the furnace, and the structure and the operation conditions of the burner as well as flame shapes were identifed as the next research subjects. (4 figs, 1 tab)

20829 (NEDOJ—8401, pp 177-181) **Development of production technology of high calorie gas. Feasibility study of a large scall gasification plant.** Aug 1984. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770050/JAW.

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As for the objects of the 1983 project to accomplish the specification of a plant of the scale of 350,000 Nm³/d class, and to obtain the conceptual design of the plant for the practical use, the results are as folows. 1. As for the factors affecting the performance of high calorie gasification process, the ratio of steam / slurry and other five factors were investigated and the methods for improving performance were identified. 2. Concerning the studies for the feasibility of large scale plant, by setting the conditions for fundamental studies of plant planning, a plant system was composed and the presumed performance was calculated. With use of these data, manufacturing cost of gas was estimated and the economy taking into consideration the cost variation of raw material and the plant scale etc. was studied and evaluated. The tremendous possibility of utilizing high calorie gas was firmly recognized. 3. As for the high calorie gasification technology, hybrid gasification processes were assessed totally and their technical features were confirmed. Furthermore, scaling-up of the system was confirmed to be feasible as a whole although some problems remain in the partial processes. As the measures to be taken for the commercialized operation, the accumulation of technical data, the establishment of the economy of the system, the maintenance of reliability of equipments and the necessity of making the most suitable processes were clearly recognized. (1 fig, 1 tab)

20830 (NEDOJ—8401, pp 182-196) **Development of production technology of high calorie gas. Development of refractories and ceramics for multipurpose high temperature gasification plant.** Aug 1984. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770050/JAW.

In FY 1983 NEDO Annual Report.

This is a report for 1983 on the development of refracrory and ceramic material for a multipurpose high temperature gasification furnace and the construction technology of cooled fireproof walls. 1. As to the problem of the deterioration of material, damage in connection with refractories and ceramics for a high temperature gasification furnace and technology of furnace building, situations of research and development in the West were investigated. 2. A preliminary investigation on slag-resistance and fundamental physical properties of conventional refractories and ceramics was conducted. 3. A corrosion test equipment for coal slag and a coal ash making equipment were developed so as to enable an evaluation test of refractories and ceramics. And an investigation and an examination on the process of material evaluation for the thermal impact resistance which is regarded as a weak point of refractories and ceramics was carried out. 4. A process of temperature distribution

analysis of cooled fireproof wall sections at the starting and the stopping time and a steady-state operating time was developed. Also an evaluating equipment for thermal physical property for evaluation of the physical property of the refractories necessary for the temperature distribution analysis was developed.

20831 (NEDOJ—8401, pp 197-198) **Development of production technology of low calorie gas. Development of power generation by coal gasification.** Aug 1984. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770050/JAW.

In FY 1983 NEDO Annual Report.

This is a report on the study of development of composite power generating system high in economy by developing a high efficiency coal low calorie gasification process and a refining process of produced gas. (1) Basic design; Among the basic design of coal gasification composite cycle power generating plant in the 1000t/d and 100MW range, mainly an examination of load performance of the plant was carried out. Also a feasibility study on a 2000MW range real plant was wxecuted so as to contribute to the basic design of the above plant. (2) Cold model test on coal gasification furnace; As an element test for coal feeding in a 1000t/d range, a characteristic test of a lock hopper and a characteristic test for confirmation of operation of pneumatic conveying equipment were performed. Also, an operating method for a high pressure furnace and a constant pressure model was established to obtain basic data. (3) Bench scale test on wet desulfurization; A tar absorption test, a desulfurization test and a tar separation test were conducted.

20832 **(NEDOJ—8401) FY 1983 NEDO Annual Report.** (New Energy Development Organization, Tokyo (Japan)). Aug 1984. 715p. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770050/JAW.

Papers in the 1983 NEDO annual report have been entered individually into EDB and ERA.

20833 (NEDOJ—8603, pp vp) **Upgrading of coal liquefied oil (Part 1). Hydrogenation refining of naphtha fraction and problems.** Fukushima, Atsushi; Ono, Shigeyoshi; Mitsuhashi, Kenshiro; Yamada, Takeo; Shinozaki, Sadayuki. (Idemitsu Kosan Co., Ltd., Chiba, Japan; New Energy Development Organization, Tokyo, Japan). 1986. (In Japanese). New Energy Development Organization, Tokyo, Japan.

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Studies on the changes of hetero-atoms in the naptha fraction of PDU crude oil of Sumitomo Metals Industry's Hazaki Research Center were carried out by micro-reacter operation applying 30-50cc of Ni, Mo, W, Al catalysts packed in fixed bed reaction tube. Results were as follows. (1) It was observed reduction of nitrogen under 1 ppm after single refining operation by 350°C, 60kg/cm². LHSV 2.5/h using hydrogenation catalysts. Ni-Mo or Ni-W, although naptha liquid contained more than 1000 ppm of nitrogen which is almost all in the aromatic heterocyclic ring. (2) Sulfur contents contained in liquid naptha 2000 ppm originally, remained 20-100 ppm as element sulfur after the refining, independent of the refining conditions. It was observed that the sulfur decomposed once became element by a reaction with ammonia or water which were produced in same time. (3) Plugging was observed in the preheating zone of reaction tube. It can be considered gummy materials produced while storage were polymerized by rapid heating, and the plugging was caused by gummy materials and accelerated by naptha evaporation. The elements which act as poison were removable for the most part, but characteristic phenomena of liquefied naptha like plugging still remained. (3 figs, 4 tabs)

20834 (NEDOJ—8603, pp vp) **High temperature gasious corrosion of alloys in coal gasification atmospheres.** Okada, Michiya; Usami, Kenichi; Morimoto, Tadaoki. (Hitachi Ltd., Tokyo, Japan). 1986. (In Japanese). New Energy Development Organization, Tokyo, Japan.

In FY 1986 NEDO Technical Report.

Studies on the high temperature gaseous corrosion of alloys in coal gasification atmospheres (CGA) were carried out by laboratory corrosion test, and the corrosion behavior were discussed thermochemically. The results were as follows. (1) Oxygen and sulfur potential were determined by equibrium calculations. Also oxygen and sulfur phase diagrams with the component of heat resistant alloys including Fe, Ni, Co, Cr and Al were made respectively. (2) Corrosion tests of Fe, Ni, Co-base alloy and Al adition alloy were conducted in a simulated CGA containing H_2, CO, CO_2, CH_4, H_2S and H_2O at 300-850°C for 100 h. Fe, Ni, Co became sulfides in CGA thermodynamically. As Ni sulfide melts at about 600°C, the heat resisting property was smallest. Co is most durable against sulfur, because of its higher anti-sulfur potential. It was observed that 2-3% aluminum addition to SUS 304 was very effective to increase the corrosion resistance in CGA. (3) The increase of the corrosion resistance was attributed to the compact oxide scale effect of Cr and Al rich layer. (4) A thermochemical model to explain this effect proved that if corrosion scale would be assumed as uniform solid solution with meta-regular solution, oxide scale were stabilized by aluminum addition. (13 figs, 7 tabs)

20835 (NEDOJ—8603, pp vp) **Direct sampling of coal-derived liquid from 2.4t/d PDU reactors.** Ogawa, Takashi; Miyazawa, Kunino; Toma, Ichiro; Maeda, Akihiro; Sakai, Naohide. (Nippon Kokan K.K., Tokyo, Japan). 1986. (In Japanese). New Energy Development Organization, Tokyo, Japan.

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A device for directly collecting samples from the reactors in a 2.4t/d PDU coal liquefaction plant was elaborated. Using this device, samples were collected from the reactors. The plant had three reactors in series. The run conditions were as follows: The pressure was 200 to 250 kg/cm²G; the temperature was 420°C to 445°C. Sampling nozzles were inserted at high, medium, and low levels in the reactors, and were provided with a valve for each. This valve was opened and closed for sampling. Sampling of solid materials was done in long-term liquefaction operation. The time-dependent changes in the concentrations of the ash and toluen insoluble (TI) components in the samples were compared with those in the slurry. The concentration changes in the samples were very similar to those in the slurry; this has revealed that this sampling technique allows the solid component concentrations to be monitored satisfactorily. This was also demonstrated by a comparison between the changes in the Fe and Ca contents in the samples and those in the slurry. The results of the sampling have proved that solid sedimentation does not occur in the reactors. Gas and light components could not be sampled correctly. (9 figs)

20836 (NEDOJ—8603, pp vp) **Gas hold-up in a coal liquefaction reactor.** Ishibashi, Hirohito; Yokoyama, Kei; Sakai, Naohide; Ogawa, Takashi. (Nippon Kokan K.K., Tokyo, Japan). 1986. (In Japanese). New Energy Development Organization, Tokyo, Japan.

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Gas hold-up in a coal liquefaction reactor was determined as one of data to be collected concerning fluidity characteristics in the coal liquefaction reactor basing on 2.4 t/d PDU used as a tool for proceeding reaearch and development entrusted by NEDO. The gas hold-up in a coal liquefaction reactor composed of three towers of 240 mm diameter X 2400 mm height was determined by three methods. (1) Gas shielding method; Feed of oil was continued but the feed of gas was interrupted momentarily, and the time was measured until the liquid from the reactor to a high temperature separator overflowed again, (2) Gas purging method; Pressure difference P between the top and the bottom of the reactor was measured and the gas hold-up (EG) was calculated using an equation: $P/l=RL(1-EG)+RGxEG$ (where l is the distance between the top and the bottom of the reactor, and RL, RG are the density of the gas), and (3) Neutron attenuation method; Residence time in the reactor was determined using a neutron irradiation device and a neutron detector attached to the outlet of the reactor. Obtained data from each method coincided well. The gas hold-up in the stage of cold oil run showed dependence on the pressure, but this dependence was not recognized above 130 kg/cm²G. In the coal liquefaction run and the hot oil run, when the linear velocity of the gas was above 4.0 cm/sec, the gas hold-up approached asymptotically to a fixed value, and a relation expressed by the formula: $EG/(1-EG)=0.113\ UG\ exp(1.2)$ was found. where UG is space velocity in tower in cm/sec. (6 figs)

20837 (NEDOJ—8603, pp vp) **Operation of coal slurry heater. Estimation of slurry by ΔP cell.** Yokoyama, Kei; Takenaka, Joichi; Maeda, Akihiro; Toma, Ichiro. (Nippon Kokan K.K., Tokyo, Japan). 1986. (In Japanese). New Energy Development Organization, Tokyo, Japan.

In FY 1986 NEDO Technical Report.

It was necessary to obtain flow data of a coal slurry at high temperature in a coal slurry preheater to design a preheater of a 250 ton/d pilot plant for bituminous coal liquefaction. As an object of the research and development using 2.4 ton/d PDU entrusted by NEDO, pressure drops in preheater tubes were determined during 9 runs of continuous coal liquefaction. Run conditions were ca. 250 kg/hr slurry feed, 100150 Nm^3/hr gas feed, 150°C/390°C inlet/outlet temperature of slurry, 205-215 kg/cm^2G pressure at the inlet of the preheater. ΔP cells were attached to preheating tubes. The runs were carried out using 5 levels of Illinois coal density as the feed slurry. Obtained values of the pressure drop were under two phase flow conditions (circulating gas phase and coal slurry phase), the values were treated for the calculation of effective viscosity in accordance with Lockhart-Martinelli method. On the other hand, the viscosity of the slurry at high temperature and high pressure were determined separately with a high temperature high pressure viscometer supplied by Iwamoto Seiki Co. Ltd. The values calculated from the pressure drop were considerably lower than the values determined by the viscometer. But the method for estimating the viscosity from pressure drop used in this investigation were considered to be applicable to the design of preheating furnace of the pilot plant. (5 figs, 1 tab)

20838 (NEDOJ—8603, pp vp) **Analysis of coal derived pitches by PyGC/MS.** Kaihara, Mikio; Ichida, Shoji; Mametsuka, Hiroaki; Iwata, Hideo; Mrotomi, Hidetoshi; Okada, Toshihiko; Matsubara, Kenji. (Nippon Kokan K.K., Tokyo, Japan). 1986. (In Japanese). New Energy Development Organization, Tokyo, Japan.

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The analysis method according to Pyrogenic gas chromatograph mass spectrometry (PyGC/MS) was applied to analysis of heavy hydrocarbons. And it was estimated that characterization of pitches by PyGC/MS was useful for studying coal liquefaction behaviour, coal gasification behaviour and development of uses for pitches. Test apparatus of Japan Electronics Make DX300 type GC/MS and OV101, 50M capillary column were used. As analytical conditions, initial temp. of 100°C, temp. rise 8°C/min, final temp. 300°C were applied. Also, as thermal cracking apparatus, high frequency heating analysis device JHP-3 type of Japan Analysis Industry make was employed and coal liquefaction was carried out on pulverized coal (under 80 mesh) + 15 times vol. creosote + red mud sulfur (catalyst). Regarding 4 kinds of coal liquefaction residues, results were obtained as follows: Regarding Yaroon coal and Illinois No. 6 coal, mainly bicyclic aromatic hydrocarbons, while for Taiheiyo coal mainly quadcyclic aromatic hydrocarbons were derived. With Horonai coal only, a little decomposed product resulted, with unidentified components detected. (4 figs)

20839 (NEDOJ—8603, pp vp) **Determination of molecular weight and distribution of preasphalten in lignite liquefaction.** Okazaki, Keishin; Takeshita, Yasuhiro; Saito, Kaizaburo; Nakako, Yukio. (Idemitsu Kosan Co., Ltd., Tokyo, Japan; Kobe Steel Ltd., Kobe, Japan; Nippon Brown coal Liquefaction Ltd., Tokyo, Japan). 1986. (In Japanese). New Energy Development Organization, Tokyo, Japan.

In FY 1986 NEDO Technical Report.

Size Exclusion Chromatography (SEC) using n-methyl pyrrolidine (NMP) was carried out to evaluate heavy component of 1st stage Coal Liquefied Bottoms (CLB:boiling point; above 420°C) produced in 2 stage method of Australian Brown Coal Liquefaction. Comparing SEC by NMP method and pridine method application of SEC for reaction analysis was studied. As testing apparatus a 0.1 t/d process development unit was used and as sample fractionated products of CLB were used. As a result the NMP and pyridine calibration curves showed good dependence on a MW range of 10^6- several hundreds. In comparison of preasphaltene molecular weight, NMP system was more effective in the measurement in high molecule area than the pyridine system. The solubility of high molecular weight matter by NMP was satisfactory. Also, at the time of rise of reaction temperature in primary hydrogenation, CLB products decreased and high molecular weight elements decomposed with PI matter not increasing. This study was done as a study entrusted by NEDO. (2 figs, 1 tab)

20840 (NEDOJ—8603, pp vp) **Coal cleaning for liquefaction. Pretreatment of coal by iron sulfate.** Akiyama, Masaru; Otaka, Yasuo; Matsuo, Kiyotaka; Matsui, Shigeru. (Sunitomo Coal Mining Co., Ltd., Tokyo, Japan). 1986. (In Japanese). New Energy Development Organization, Tokyo, Japan.

In FY 1986 NEDO Technical Report.

Substances causing deposition in a coal liquefying reactor such as Ca and Mg are removed by cleaning. The cleaning effect and suitability of cleaned coal using iron sulfate for liquefaction are investigated. Samples are treated with aq. iron sulfate adjusted to a specified pH, stirred in N_2 atmosphere, filtered and washed, then dried under reduced pressure. The percentages of removed Ca, Mg, and Fe in the dried product were determined using atomic absorption spectroscopy For Taiheiyo Coal. The lower the pH at the cleaning, the higher the percentages of removal were for both Ca and Mg, attaining finally a constant value; the value for Ca was higher than the value for Mg. Cleaning at lower pH was concluded to be more preferable. No difference between the cleaning effect of Fe(II) salt and Fe(III) salt was recognized. Ca and Mg were removed almost completely by about 1 hr treatment for Mowell coal, whereas only ca. 55% Ca and ca. 20% Mg were removed for Taiheiyo coal. The result may be due to presence of Ca and Mg in the form of inorganic mineral such as calcite in Taiheiyo coal. When the cleaned coal using iron sulfate and uncleaned coal were liquefied at 400°C for 60 min for Taiheiyo coal and Mowell coal, results as described hereunder were obtained. (1) The pretreatment using iron sulfate is effective for removal of Ca and Mg, particularly for coal of low carbonization degree having large oxygen content such as Mowell coal. (2) Ca and Mg in the coal are exchanged with Fe by the cleaning and the Fe content is increased, and the liquefiability of coal is improved by the catalytic effect of Fe. (2 figs, 2 tabs)

20841 (NEDOJ—8603, pp vp) **Liquefaction potentials of low rank coals. Estimation by multiple regression analysis.** Kanbayashi, Yutaka; Okada, Kiyoshi; Saito, Iki; Miwa, Tomohisa; Ikari, Masao; Osawa, Yasuhiro. (Coal Mining Research Center, Tokyo, Japan). 1986. (In Japanese). New Energy Development Organization, Tokyo, Japan.

In FY 1986 NEDO Technical Report.

Many brands of coal were tested and the coal characteristics and liquefaction characteristics were analyzed. Samples entailed 17 brands of Canadian coal, 5 Australian, 6 USA brands and 4 Japanese and other brands. Liquefaction tests were calculating product distribution after 1 hour liquefaction with initial hydrogen press. 9.8 MPa, temp. 450°C. In the group containing much exinite (E) + vitrinite(V), oil yield (O) was largest with the subbituminous coal. In the group of similar coal ranks, with the increase of E+V, a clear correlation of increased (O) was observed. The asphaltene yield (AS) increased together with the increase of the coal rank but for the subbituminous coal it decreased with the increase of (E + V). For bituminous coal it increased together with both. With the increase of both Vitrinite optical reflection rate (Ro) and (E + V), (O + AS) also increased. A regression formula was conducted, with 6 parameters and 6 variables. 6 parameters was composed of, Ro, E, V, inertinite, volatile matter and calorific value. 6 variables was composed of hydrogen consumption, water formation, gas formation, O, AS, benzene conversion. Values were estimated accurately by this formula and are applicable for product yield control. (3 figs, 1 tab)

20842 (NEDOJ—8603, pp vp) **Initial behavior of coal macerals during hydrogenation.** Okada, Kiyoshi; Kanbayashi, Yutaka; Saito, Kazumoto; Miwa, Tomohisa; Ikari, Masao; Osawa, Yasuhiro. (Coal Mining Research Center, Tokyo, Japan). 1986. (In Japanese). New Energy Development Organization, Tokyo, Japan.

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Performed as a link in the research under assignment of the NEDO. Research was carried out on the behavior during hydrogenation of macerals and maceral types of various coals, degradinite (DEG) of Taiheiyo coal, sporinite (SP) of Vandoan coal, gelo-

collinite (GC) of River King coal, and studies have been made on feasibility as parameters for the purpose of estimating hydrogenation yields of coals and coal fields. As a result the following information have been elicited. With the Taiheiyo coal degradinite, at 350°C, a part of the substrate is eluted and degradinite reaction progressing at 375°C and benzene conversion rate attaining 19%. With the Wandoan coal, fissures developed between the sporinite and vibrinite and elution of sperinite started along the fissure with nearly all the sperinite eluted at 400°C. The gelocollinite of the River King coal displayed remarkable transformation at 350-375°C, becoming structures accompanied with small holes, finally rendering sponge-like form and starting to elute at 400°C. From these results, it was learned that; the degradinite of Taiheiyo coal, sporinite of Wandoan coal and gelocollinite of River King coal, all presented the parameter to predict a negative trend of inertinite and that the macerals and maceral types are parameter of positive trends of inertinite. (1 fig, 1 tab)

20843 (NEDOJ—8603, pp vp) **Study on the secondary hydrogenation reaction conditions in BCL process.** Tachibana, Shigeo; Mito, Yutaka; Okuma, Osamu; Saito, Kaizabro. (Kobe Steel, Ltd., Kobe, Japan; Nippon Brown Coal Liquefaction Co., Ltd., Tokyo, Japan). 1986. (In Japanese). New Energy Development Organization, Tokyo, Japan.

In FY 1986 NEDO Technical Report.

In the primary Brown Coal Liquefaction (BCL) process which is the Brown Coal secondary hydrogenation process, the high b.p. distillate solvent is useful, especially in partial hydrogen compounds of the 3rd and 4th rings, hydrogen donation capacity is high. Accordingly, as a link in optimizing the process, with the 3rd and 4th rings partial hydrogen compounds as an index, effects of the product oil of the scondary hydrogenation having on the condition of secondary hydrogenation reaction (300-400°C, 100-200Kg/cm²G), and the effects on the quantity of hydrides of the 3rd and 4th rings, were studied. This study was carried out under conditions of LHSV=0.5hr⁻¹, hydrogen/crude oil=1000/1, using a Ni/Mo catalyst. The following results were attained: (1) The ratio of partial hydrogen compound (PHA) in the product oil showed the max. value at 360°C, 200 kg/cm²G. At 400°C, as the pressure increased, the PHA decreased. (2) The hydrogenation degree expressed in fa value and the hydrogen donation capacity are not necessarily proportional and an fa value of ca. 0.6 is suitable. (5 figs, 2 tabs)

20844 (NEDOJ—8603, pp vp) **Studies on initial stage in brown coal liquefaction. Liquefaction behavior initial stage.** Aiura, Masato; Kageyama, Yoichi; Watanabe, Masato; Kawai, Satoshi. (Mitsubishi Chemical Industries Co., Ltd., Tokyo, Japan; Asia Oil Co., Ltd., Tokyo, Japan; Nippon Brown Coal Liquefaction Co., Ltd., Tokyo, Japan). 1986. (In Japanese). New Energy Development Organization, Tokyo, Japan.

In FY 1986 NEDO Technical Report.

This study is performed as a research work consigned by NEDO. An object for liquefaction is Australian brown coal, and in view of the importance for developing an equibrium solvent, recycle oil obtained from PDU of brown coal liquefaction was used for solvent and liquefaction tests were performed under various reaction conditions and behavior in initial stage of liquefaction was studied. In this study, Morwell brown coal was used for test specimen and a recycle oil obtained by PDU tests (440°C, 250 atm.) having a boiling point region of 180°C - 420°C. was used. And as catalyst fine grained powder of iron ore was used. On liquefaction tests, reaction was performed in an agitating type autoclave by injecting hydrogen at a rate of 900 NL/Hr. Temperature was elevated at a rate of 15°C/min and naphtha and Coal Liquefied Bottoms (CLB) was separated by distillation. First, at solvent/coal ratio = 2 and 440°C and 190 atm. reaction time was changed from 0 - 90 min. and further, in order to study the behavi0r in process of temperature rise, reaction product was drawn out immediately after temperature rise to 400°C, and a test to rapidly cool down to room temperature was carried out. Combination of solvent produced and brown coal was relatively weak and as temperature is elevated they were cut off again, and solvent component is recovered. By simulating all reactions by means of an optimization method, time transiting change of liquefaction was favourably recurred including rise and fall stages. (1 fig, 3 tabs)

20845 (NEDOJ—8603, pp vp) **Studies on the solvents in coal liquefaction (Part 3).** Masunaga, Toshio; Aiura, Masato; Kageyama, Yoichi; Kawai, Satoshi. (Mitsubishi Chemical Industries Ltd., Tokyo, Japan; Nippon Brown Coal Liquefaction Ltd., Tokyo, Japan). 1986. (In Japanese). New Energy Development Organization, Tokyo, Japan.

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As the index of solvent ability in coal liquefaction reaction, hydrogen shifting capacity of solvent is an important factor and so we measured it. The thermal decomposition of n-tetracosane is performed by putting fixed quantity of n-tetracosane 1 g and model compound or sample solvent in a microbomb of 5 ml volume and sealing the tube after nitrogen replacement and reacting with agitation in the sand bath of 450°C for 30 minutes. After the end of reaction, all quantity of the produced liquid is solved into THF and with use of GC unreacted n-tetracosane and model compound are estimated and the decomposition rate of n-tetracosane and dehydrogenated quantity from model compound are calculated. As the result, these values of data coincide considerably well with the hydrogen shifting capacity to coal, and the decomposition rates of n-tetracosane in this case are as follows; tetralin 50%, octahydro-anthracene 30%, dihydroanthracene 20%, dihydrophenanthrene 10%. Under the existence of actual liquefaction solvent, the decomposition of n-tetracosane is recognized to have a very good correlation with the liquefaction rate of coal, so it is a good index of ability. Then by measuring this decomposition rate, one is able to know the radical stabilizing effect of the liquefaction solvent under conditions similar to the the actual state. (2 figs, 1 tab)

20846 (NEDOJ—8603, pp vp) **Studies on the solvents in coal liquefaction (4).** Kaneko, Shinji; Masunaga, Toshio; Kageyama, Yoichi; Kawai, Satoshi. (Asia Oil Co., Ltd., Tokyo, Japan; Mitsubishi Chemical Industries Co., Ltd., Tokyo, Japan; Nippon Brown Coal Liquefaction Co., Ltd., Tokyo, Japan). 1986. (In Japanese). New Energy Development Organization, Tokyo, Japan.

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This study is a study entrusted by NEDO. Hydrogen shifting capacity is regarded as an indicator showing properties of solvent in coal liquefaction. For the determination of it, a fa has so far been proposed for checking degree of this capacity and ^{13}C-NMR process and sulfur dehydrogenation process have been proposed as a method for measuring the same. However, the measuring conditions in these proeesses applying ordinary temperature or at most around 230°C differs from the actual condition of liquefaction. A new method utilizing n-paraffin decomposition has been recently developed. In this method, the hydrogen shifting capacity and hydrogen shifting facility are measured. Through applying this method, n-paraffin decomposition ratio of actual coal liquefaction product especially HDAO (hydrogenated deashed oil) was investigated on its n-paraffin decomposition and relationship between its properties and liquefaction. As a result, it was cleared that so far regarded as the indicator is hardly admissible as the indicator for distillate with higher saturated component and that the ^{13}C-NMR process providing measurement of hydrogen shifting capacity does not provide measurement of shifting velocity, thus showing a discrepancy from hydrogen transfer in actual liquefaction. On the other hand, the n-paraffin decomposition method is considered as a more favorable indicator in view of its allowing measurement in the conditions close to the actual liquefaction. Furthermore, it is clear that the method is compatible with the coal solubility. (3 tabs)

20847 (NEDOJ—8603, pp vp) **Studies on the hydrocracking of deashed oil (4).** Kimura, Takao; Masuyama, Tetsuo; Kageyama, Yoichi; Koike, Yasuo; Kawai, Satoshi. (Asia Oil Co., Ltd., Tokyo, Japan; Mitsubishi Chemical Industries Ltd., Tokyo, Japan; Nippon Brown Coal Liquefaction Ltd., Tokyo, Japan). 1986. (In Japanese). New Energy Development Organization, Tokyo, Japan.

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When secondary hydrogenation process is proceeding using, as feed materials, deashed oil that is produced from primary hydrogenation process of Australian brown coal and deashing process of its products, coke formation occurs on the catalyst and disturbs the hydrogenation operation. Structural change in the metal that supports catalyst Ca-Ni-Mo/Al_2O_3 was analysed during desulfuriza-

tion, aging and cracking reaction, to study how Ca works for prevention of coke formation. In the fresh catalyst, quantity of $CaMoO_4$ was found which decreases during desulfurization and aging, and formation of MoS_2, CaS, and Ni_3S_2 was observed. The result of X-ray diffraction analysis , structural changes observed in X-ray photoelectron spectroscopy, Raman spectroscopy, and the result of X-ray microanalyser analysis made at 500 hours after the reaction are given with figures. In the fresh catalyst, Ca forms $CaMoO_4$ together with Mo. With the progression of sulfuration, the crystallinity is lost to form respective sulfides. However, Ca existing near active metal Mo can be considered to retard coke formation.

20848 (NEDOJ—8603, pp vp) **Thermochemical studies on the reactivity of model solvent compounds in coal liquefaction.** Kawai, Satoshi; Kageyama, Yoichi. (Nippon Brown Coal Liquefaction Co., Ltd., Tokyo, Japan; Mitsubishi Chemical Industries Ltd., Tokyo, Japan). 1986. (In Japanese). New Energy Development Organization, Tokyo, Japan.

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In this study, the released speed of hydrogen in various hydrogen donating solvents were investigated, and the relation between the quantity of created heavy material and the change of free energy of hydrogen release were also investigated, when brown coal was liquefied with the model solvent. The steps of the investigation were as following. (a) The free energy change was investigated at first, which occurred by reaction caused when the hydrogenated solvent was composed by adding hydrogen to the model solvent. (b) Then, the change above was compared with the reactivity of the hydrogenated model solvent in the realistic condition which was considered as hydrogen was dominating. As the result, the quantity of free energy decreased and the reaction speed became greater or higher, as coming near dihydrophenanthrene and far from tetralin. It means that there was a good correlation. But, as coming near dihydroanthracene and octahydroanthracene, the quantity of free energy decreased became less and the reaction speed became higher. It means that there was a reverse correlation. About the reaction creating heavy material, it became clear that the quantity of heavy material created became less, as the quantity of free energy of hydrogen release decreased became greater. It means that there was a good correlation, and it is reasonable because a solvent which releases hydrogen easily gives hydrogen easily to the material created. (2 figs, 2 tabs)

20849 (NEDOJ—8603, pp vp) **Studies on initial stage in brown coal liquefaction. Behavior of liquefaction under initial process.** Aiura, Masato; Kageyama, Yoichi; Watanabe, Masato; Kawai, Satoshi. (Mitsubishi Chemical Industries Ltd., Tokyo, Japan; Asia Oil Co., Ltd., Tokyo, Japan; Nippon Brown Coal Liquefaction Co., Ltd., Tokyo, Japan). 1986. (In Japanese). New Energy Development Organization, Tokyo, Japan.

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Liquefaction experiments were conducted under various reaction conditions making use of a liquefaction recycling oil, which is the product obtainable on PDU. A sample used Morwell coal, a solvent, the above-mentioned oil, and a catalyst, a finely powered iron ore. The reaction was taken place in the autoclave of rotary churning electromagnetic induction type by blowing hydrogen gas of 900 NL/Hr through. The temperature was raised at the rate of 15°C/min. After the reaction was finished for the prescribed hours at the appointed temperature, it was cooled to the limit of the room temperature. The fractionl naphtha (C_5-180°C), fractionl solvent (180-420°C) and CLB (Coal Liquid Bottoms;above 420°C) were separated by distillation. H_2 consumption rate was faster in the early stages, and as the reaction went on, the rate went down rapidly. The change of fa values (aromaticity) of recovered solvent, which is reacted under various conditions, was examined. Considering a mechanism of reaction of the brown coal liquefaction additioning characteristics such as an annexing solvent, a completion of CO product, etc, in full consideration of these conditions, a constant of reaction rate was supposed as $K = Aexp(-E/RT)$ and all reactions were simulated by optimum method. On the supposition that the reaction is the first order one, the change of liquefaction time, including that in stages of raising temperature, was well reproduced. (5 figs, 1 tab)

20850 (NEDOJ—8603, pp vp) **Estimation method for the equilibrium state in coal liquefaction process.** Hayakawa, Keiichi; Kurachi, Kazuhito; Yao, Tadashi. (Sumitomo Metal Industries Ltd., Tokyo, Japan). 1986. (In Japanese). New Energy Development Organization, Tokyo, Japan.

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In this experiment, dried and ground Wandowan coal as test material, the solvent obtained by 1 t/d PDU and CGS catalyst obtained by the gasifier which was made by Sumitomo Metal Industries Ltd., were used. The test material was put into a 0.5 l autoclave, then it was heated and acted upon for a fixed time at a fixed temparature, under the condition of hydrogen pressurized. After completion, the autoclave was cooled rapidly by the fan. The gaseous products in the autoclave were analyzed by a gas chromatograph. The liquid products were distilled and the fraction was separated from water and the residual, then the fraction was analyzed with a distillation gas chromatograph. The results were as following. (a) The data obtained by the experiment concurred with the value obtained by the model which we made to calculate hydrocracking reaction of the solvent as the first stage reaction occurred one by one, and in parallel. (b) We made a model to estimate the recycle solvent fraction, which was used for estimating the equilibrating composition of the recycle solvent in combination with the model for lightenning solvent reaction in hydrogenating process. As the result above, it became possible to estimate the equilibrium value of the recycle solvent. (c) By using this model, the composition of the products from coal by 5 l autoclave and 1 t/d PDU were estimated, and we found that the 1 t/d PDU products were heavier than the 5 l autoclave products. It was considered that the difference above was caused by the difference of reaction characteristics of devices. (4 figs, 3 tabs)

20851 (NEDOJ—8603, pp vp) **Studies on the thermal behavior of vacume bottom oil from coal liquefaction process (Part 2).** Kurachi, Kazuhito; Hayakawa, Keiichi. (Sumitomo Metal Industries Ltd., Osaka, Japan). 1986. (In Japanese). New Energy Development Organization, Tokyo, Japan.

In FY 1986 NEDO Technical Report.

Operation results of NEDOL process verification based on 1 t/d plant. Studies were carried out as a research entrusted by NEDO. 1) Studies of thermal behaviour of vaccum bottom oil in coal liquefaction; 1 kg of slurry from the distillation column bottom in the 1 t/d PDU liquefaction process was used. With the extension of thermal reforming time, HS and HI-TS decreased while TI-QS increased. With the rise in thermal reforming temp. HS decreased while TI-QS and HI-TS increased. Further, with the longer thermal reforming time, and higher the thermal reforming temp. the amount of distillate during the distillation decreased. Here, HS; normal heptane soluble, HI-TS; normal heptane insoluble and toluene soluble, TI; Toluene soluble. 2) NEDOL process verification operation on a 1 t/d plant; After sulfuration treatment of the solvent hydrogenation process catalyst, hydrogenation was precedingly carried out. After all processes were normalized, naptha distillate and middle oil distillates were periodically extracted outside the system. As a result, the condition of oil yield of above 50daf by the NEDOL method mode was proved. Also prior to solvent hydrogenation, heavy oil of 30% concentration, fa about 0.47, was generally balanced as to properties of recycle solvent.

20852 (NEDOJ—8603, pp vp) **Brown coal liquefaction technology.** Nakako, Yukio; Kawai, Satoshi. (Nippon Brown Coal Liqnefaction Ltd., Tokyo, Japan). 1986. (In Japanese). New Energy Development Organization, Tokyo, Japan.

In FY 1986 NEDO Technical Report.

This report covers the BLC Process for liquefaction of Victoria Brown Coal carried out by the Japan BCL Co. on assignment from the NEDO. 1) Dehnydrating process: Carried out in energy conservation style by slurrying pulverized brown coal in a solvent and heating to evaporate the water content. 2) Primary hydrogenation process: Using a non-recoverable catalyst succeeded in mitigating conditions to 150 kg/cm² pressure and temperature less than 450°C. Heavy oil together with a solvent (mainly medium oil) was partly restored to pre-reaction state and oil yield was increased. 3) Deashing process: Heavy oil was diluted with solvent and insolubles and ash contents subjected to coagulation-sedimentation attaining deashed oil of less than SS 1000 ppm, thus preventing deteriora-

tion of the catalyst. 4) Secondary hydrogenation process: Deashed oil and solvent were mixed and under high temp.high pressure, supplied together with hydrogen to a fixed bed. By using anti-coking catalyst of Co-Mo type, it was rendered impossible to adopt a fixed bed reactor, so the ash content of the heavy oil produced was concentrated and flow divided by the liquid cyclone, returned to the primary hydrogenation side and the oil yield increased to over 50%. The pilot plant in Australia completed works for primary hydrogenation in 1985 and after trial run, attained their goal in the fall of the same year and is operating smoothly after minor corrections of the auxiliary system. The second stage work on the secondary hydrogenation system is progressing satisfatorily. (4 figs, 2 tabs)

20853 (NEDOJ—8603, pp vp) **Liquefaction process of brown cool.** Okazaki, Keiji; Saito, Hiromi; Muramatsu, Kazumi; Nishi, Katsuyuki; Mitsuhashi, Yozo; Kawai, Satoshi; Taki, Yoshihiro. (Kobe Steel Ltd., Kobe, Japan; Asia Oil Ltd., Tokyo, Japan; Mitsubishi Chemical Industries Ltd., Tokyo, Japan; Nippon Brown Coal Liquefaction Ltd., Tokyo, Japan). 1986. (In Japanese). New Energy Development Organization, Tokyo, Japan.

In FY 1986 NEDO Technical Report.

Brown coal from reserves in Victoria, Australia is planned to be transformed to liquid fuel by the brown coal liquefaction project under agreenment between Japanese and Australian Governments concluded in 1980. The project is committed as one item of the Sunshine Project of MITI to Nippon Brown Coal Liquefaction Co., Ltd. The process is based on the C-SRC process which has been developed by Kobe Steel Ltd. and others, in which the Australian brown coal is hydrogenated in two stages by taking consideration in the liquefaction characteristics of the brown coal to obtain high yield of liquefied oil and high economic efficiency. 50 t/d pilot plant has been constructed in Mowel in State of Victoria, Australia, which is now in operation. After expanding the scale to 5,000 t/d, 30,000 t/d plant is intended in future. Since the ash content is small, coal preparation process is unnecessary. The feed coal is brought into the form of slurry by mixing with circulating solvent. After dehydrating the slurry in an evaporator, the coal is hydrogenated in the primary hydrogenation stage with H_2 at 430-450°C under 150-200 atm to cause hydrocracking and obtain liquefied oil. A part of the liquefied oil is circulated as solvent, and the rest is fractionated to heavy oil, middle oil, and naphtha. The heavy oil is deashed in the solvent deashing stage, then hydrogenated in the secondary hydrogenation stage together with the middle oil at 350-400°C under 150-200 atm in a fixed catalyst bed to transform to light oil, which is fractionated into middle oil and naphtha. A part of the middle oil is circulated to thr primary hydrogenation stage as circulating solvent, and a part of naphtha is used as deashing solvent, and the rest is taken out as product together with the naphtha produced in the primary hydrogenation stage. Simulation of the reaction is to be prepared from the data of the pilot plant, and scale-up data are accumulated. (14 figs, 1 tab)

20854 (NEDOJ—8603, pp vp) **Liquefaction of victorian brown coal. Liquefaction behavior in continuous stirred tank reactors in series.** Yanai, Shun'ichi; Okuma, Osamu; Murakoshi, Koji; Saito, Kaizaburo; Nakao, Yukio. (Kobe Steel Ltd., Kobe, Japan; Nippon Brown Coal Liquefaction Co., Ltd., Tokyo, Japan). 1986. (In Japanese). New Energy Development Organization, Tokyo, Japan.

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It is important to clarify the liquefaction behavior of every reactor for the operation of plants and optimization of processes. Thereupon, making use of the primary hydrogenation PDU cosisting of the three continuous stirred tank reactors in series, Victorian brown coal was liquefied, and the yields of products and the properties were examined at every reactor. The brown coal used in the experiments was Morwell coal and solvents were creosote oil (A) and circulating solvent (B). Informations obtained were as follows; 1) The production of H_2O and CO + CO_2 finished nearly at the first reactor and oil distillate was produced mostly at the first reactor. Conversion to oil from Coal Liquid Bottom (CLB) was done approximately at the second reactor and the third reactor. 2) The reduction of CLB yields to the number of tanks (reaction time) was mainly caused by the reduction of BI-PS fraction. To a certain extent differences were observed on reaction mechanism of heavy distillate depending on the quality of the solvent, and the amount of hydrogen transfer varies with the result and moreover it was considered that the quality of a solvent influenced the yield of oil fraction. (5 figs, 3 tabs)

20855 (NEDOJ—8603, pp vp) **Fundamental study on the distillation of brown coal liquefaction products.** Masuda, Kaoru; Hirano, Tatsuo; Okuma, Osamu; Saito, Kaizaburo; Nakako, Yukio. (Kobe Steel Ltd., Kobe, Japan; Nippon Brown Coal Liquefaction Co., Ltd., Tokyo, Japan). 1986. (In Japanese). New Energy Development Organization, Tokyo, Japan.

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Using gas chromatography (GC), the relationship between boiling points and retention times concerning materials included in coal liquefied oil. Calibration curves, which are conforming to properties of brown coal liquefied oil were made from the result and a composition analysis of the oil. The sample was a liquefied oil which was made from coal using a continuous hydrogenation device. A primary hydrogenation oil was made by a circulation solvent refluxing five times under certain conditions which were at a temperature between 430 and 450 °C and a pressure of 15 MPa. A secondary hydrogenation oil hydrogenated again the primary one at a pressure of 15 MPa, a reaction of 1 hour and at a temperature between 360 and 400 °C using of a NiMo catalyst. The composition analysis of the liquefied oil was examined by gas chromatography / mass spectroscopy (GC/MS) and the capillary GC. Judging from the consequence which examined thoroughly the curve in order to adopt the GC distillation to the brown coal liquefied oil, it became clear that the primary hydragenation oil having fair aromaticity can use the calibration curve of the boiling points for aromatic compounds. The secondary hydrogenation oil holds many hydrides in solution. Therefore, some other calibration curves are necessary. (5 figs)

20856 (NEDOJ—8603, pp vp) **Structural analysis of heavy distillate (oil fraction) derived from brown coal by HPLC and FD/MS methods.** Okazaki, Keishin; Takeshita, Yasuhiro; Tachibana, Shigeo; Saito, Kaizabro; Nakako, Yukio. (Idemitsu Kosan Co., Ltd., Tokyo, Japan; Kobe Steel Ltd., Kobe Japan; Nippon Brown Coal Liquefaction Co., Ltd., Tokyo, Japan). 1986. (In Japanese). New Energy Development Organization, Tokyo, Japan.

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Separation and preparation by HPLC chromatography method and FD/MS spectroscopy method for preparation components were conducted with the purpose of finding out a structural analysis of a oil fraction in Coal Liquid Bottom (CLB). The oil fraction for this experiments is a n-hexane soluble fraction of CLB produced by process development unit which is able to produce 0.1 t per day under conditions at a pressure of 14.8 MPa and at a temperature of 450 °C. It is considered that the oil fraction has molecular weight of the order of 200-500 for its main ingredients and contains small amount of n-paraffin and phenylic hydroxyl radicals. In mass number of the order of 202-334, and 350-502, the groups peak which are polycyclic aromatic hydrocarbons (PAH) and n-paraffin could be found out, respectively. Moreover, separation and preparation of the oil fraction by HPLC and FD/ MS method of preparation fraction were carried out on that point. Cousequently, a kind of PAH in the oil fraction could be separated in accordance with degree of hydrogenation of aromtic nucleus and a alkyl substituent radix by reversed-phase chromatography using of water / pyridine. A main structural image of the oil fraction is not random structure consisting of many components but may be a few kinds of PAH including pyrene and their alkyl substituents and hydrides. (7 figs, 2 tabs)

20857 (NEDOJ—8603, pp vp) **Studies on the hydrocracking of deashed oil (Part 4).** Kimura, Takao; Koike, Yasuo; Masuyama, Tatsuo; Kageyama, Yoichi; Kawai, Satoshi. (Asia Oil Co., Ltd., Tokyo, Japan; Mitsubishi Chemical Industries Ltd., Tokyo, Japan; Nippon Brown Coal Liquefaction Ltd., Tokyo, Japan). 1986. (In Japanese). New Energy Development Organization, Tokyo, Japan.

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Structural changes of Ca-Ni-Mo/Al_2O_3 catalyst was observed after sulfurization and aging treatments, and catalytic reac-

tion of hydrocracking. Also, the behaivior of metallic elements held in catalyst was surveyed to find inhibiting mechanisms. Hydrocracking was carried on deashed oil / hydrogenated creosote oil (DAO/HCRO) at 400°C, 100 atm condition. After cresing by tetrahydrofuran and drying, catalyst powder was analyzed by X-ray diffraction (XRD) and cross section analysis was made by X-ray microanalyser (XMA). Also, Raman spectroscopic analysis of sintered sample and X-ray photoelectronic spectroscopic analysis was performed on fine catalyst. XRD revealed existence of larger crystal of $CaMoO_4$ in initial catalyst, and reducing with reactions as sulfurization, aging of catalyst, and hydrocracking. These changes indicated presence of sulfides in catalyst elements. XPS spectrum of Mo3d presented the change of $Mo^{4}+$ (MoS_2) from $Mo^{6}+$ ($MoO^{2-}{}_4$). (4 figs)

20858 (NEDOJ—8701, pp 7-10) **Development of bituminous coal liquefaction technology. Supporting study to pilot plant (Study by dismantle of 2.4 t/d-plant).** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A14. Order Number DE88770075/JAW.

In FY 1986 NEDO Annual Report (Part 1).

Study was made by dismantling the 2.4 t/d-experimental plant to obtain the technical information required for the design, construction and operation of a commercial plant. The data for the design and construction of a 250 t/d-pilot plant such as the materials and structures of the components, piping and instruments were obtained. The overhaul inspection was made to observe the situation of the equipment as well as take the samples for the material tests of equipment. The samples were submitted to destructive tests such as the inspection of structure, Charpy test, tensile test and chemical analysis. After sampling, the components of the plant were diverted to the 1 t/d-process supporting unit and sold to effectively utilize the property. In putting together the findings, the coal-derived liquid was analyzed again to compare with petroleum oil and the experiment was made using the high-temperature and high-pressure viscometer to supplement the data from the experimental plant and further develop the NEDOL process.

20859 (NEDOJ—8701, pp 11-16) **Development of bituminous coal liquefaction technology. Supporting study to pilot plant (Study by 1 t/d-plant).** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A14. Order Number DE88770075/JAW.

In FY 1986 NEDO Annual Report (Part 1).

The experiment by the 1 t/d-plant was made in FY 1986 to conducted for the design of a 250 t/d-pilot plant. The purpose of the experiment was to acquire the process data using two ranks of bituminous coal. The yield of coal-derived liquid and the properties of circulating solvent were examined using No. 6 Illinois and Battle River Coals for the NEDOL process. Corrosion and pitting of the components were inspected. The relationship between the liquefaction conditions and the yield of products was determined by regression analysis of the data obtained from the 1 t/d-plant to acquire the engineering data of the 250 t/d-pilot plant. The viscosity of various coal slurries in the preheater of slurry fed to liquefaction were estimated. The composition of hydrocarbon in five samples of circulation solvent was analyzed. The basic data such as equilibrium value of the solvent used for the 1 t/d-plant and the residue drawn out of it were obtained by the experimental recycle operation using a batchwise autoclave. (1 tab)

20860 (NEDOJ—8701, pp 17-21) **Development of bituminous coal liquefaction technology. Supporting study to pilot plant (Development of optimum deashing technology of coal for liquefaction).** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A14. Order Number DE88770075/JAW.

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The deashing technology of coal for liquefaction was developed to improve the yield of liquefied oil and reduce the abrasion of valves and piping in the pilot plant of bituminous coal liquefaction. The gravity concentration test, evaluation of liquefaction characteristics of deashed coal and removal method of injurious components were investigated. The results indicate as follows: the separability in a heavy liquid cyclone varies according to the shape of cyclone; the optimization of the flow rate of heavy liquid and of the back pressure of underflow, and the stabilization of dense medium solid are required for improving the separation efficiency; the separation properties of coal depend upon the sink-float analysis results; the yield of oil from the deashed coal is higher than that from the raw coal; and the utilization efficiency of hydrogen by the deashed coal is equal to or higher than that to the raw coal. Some knowledge on the removal of Ca and Mg was obtained by the leaching test of coal using the iron sulphate solution, the heating test at a temperature of 200 to 250°C and the water-extraction test in the CO_2- atmosphere. (1 fig)

20861 (NEDOJ—8701, pp 22-25) **Development of bituminous coal liquefaction technology. Supporting study to pilot plant (Study on optimization of solvent hydrogeneration process).** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A14. Order Number DE88770075/JAW.

In FY 1986 NEDO Annual Report (Part 1).

The evaluation of the circulation solvent in the NEDOL process of bituminous coal liquefaction was established and the operation control system of solvent hydrogenation process was investigated. The circulating solvent by distilling the slurry derived from the liquefaction of Illinois No. 6 coal in the 1 t/d-PDU was hydrogenated. The liquefaction reaction was analyzed from the hydrogenated solvent and the function of solvent was evaluated. It is possible to estimate the optimum point of the function of circulating solvent for the coal applicable to the NEDOL process by determining the H/C ratio in the number of atom and the specific gravity of the solvent. The liquefaction rate of the NEDOL process using both catalyst and hydrogenated circulation solvent is higher than that of the direct hydrogenated circulating solvent using the catalyst alone. The correlation of H/C ratio-specific gravity is an excellent factor as the determination method for evaluating the function of solvent and besides, it is able to be used for the on-line analysis. The solvent function control system will be feasible by using the correlation. (2 figs)

20862 (NEDOJ—8701, pp 26-30) **Development of bituminous coal liquefaction technology. Supporting study to pilot plant (Study by 1 t/d-process supporting unit).** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A14. Order Number DE88770075/JAW.

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The purpose of this study is to construct and operate the 1 t/d-process supporting unit (PSU) to effectively develop the coal liquefaction technology by the NEDOL process, to determine the optimization and the optimum operational conditions and to support the study on a 250 t/d-pilot plant. The preparatory works for the construction of PSU such as construction of facilities, investigation and planning of research program, technical research, environmental investigation, application to the government, and search, investigation and repair of the equipment diverted from other plants were made in FY 1986. It was confirmed that the property-analysis values of liquefied oil in the PDU meet the requirements for the design of PSU. The analytical methods of crude liquefied oil and solvent-insolubles of liquefaction residue were investigated as part of the standardization of the analytical methods of coal-derived liquid. The result indicates that the Japanese Industrial Standards (JIS K-2425) can be applied to those analyses.

20863 (NEDOJ—8701, pp 31-37) **Development of bituminous coal liquefaction technology. Supporting study to pilot plant. (Study on conditions of coal liquefaction by small apparatus).** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A14. Order Number DE88770075/JAW.

In FY 1986 NEDO Annual Report (Part 1).

The purpose of this study on the development of bituminous coal liquefaction is to investigate the optimum conditions of coal liquefaction and the liquefaction characteristics of various ranks of coal and to acquire the technical information required for the design, construction and operation of a large pilot plant by the NEDOL process. The 0.1 t/d-bench-scale unit was operated using five ranks of coal including Wandoan coal selected as the standard coal for designing a 250 t/d-pilot plant by the NEDOL process. The findings obtained in FY 1986 were as follows: the NEDOL process was demonstrated by the steady operation of the whole plant and self-supporting circulation of the solvent; the cut at 538°C was obtained in the distillation process of liquefied oil; the residue in the vacuum distillation tower is softening at 180°C or

higher and the ash content of it is 30 wt% or more; and the oil yield to daf coal was as high as 50 wt% or more. (1 fig, 4 tabs)

20864 (NEDOJ—8701, pp 38-42) **Development of bituminous coal liquefaction technology. Supporting study to pilot plant (Study on solvent hydrogenation catalyst by small apparatus).** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A14. Order Number DE88770075/JAW.

In FY 1986 NEDO Annual Report (Part 1).

The purpose of this study is to develop the catalyst for decomposing n-paraffins in the circulating solvent of hydrogenating the solvent. The catalyst is the one prepared by getting nickel and molybdenum supported on the carrier of porous alumina in which zeolite is dispersed. The relationship between the components of catalyst and the activity was investigated using the circulating solvent for Wandoan coal liquefaction sampled from the 1 t/d-PDU. The hydrocracking activity of C_{23}^+ n-paraffins was improved by increasing the content of zeolite in the high-silica zeolite selected in FY 1985. Alumina was selected as the carrier matrix in which zeolite is dispersed. The average particle diameter of the alumina providing the maximum activity for the hydrogenation and the decomposition of C_{23}^+ n-paraffins was determined. The characteristics of hydrogenation and decomposition of n-paraffins were improved by increasing the supported amounts of nickel and molybdenum.

20865 (NEDOJ—8701, pp 43-50) **Development of bituminous coal liquefaction technology. Basic and detailed designs of pilot plant.** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A14. Order Number DE88770075/JAW.

In FY 1986 NEDO Annual Report (Part 1).

The purpose of this study is to demonstrate the NEDOL process by design, construction and operation of the pilot plant, to establish the operational technique and to acquire and accumulate wide range of data and knowledge required for a commercial plant. The detailed design of a 250 t/d-bituminous coal liquefaction pilot plant was made and the technical information for applying to the government was developed in FY 1986. The solutions to the problems decided in FY 1985. were executed and the operational program was developed and reviewed. The designs of the main four sections, coal pretreatment, coal liquefaction, distillation of liquefied oil and solvent hydrogenation, and of the accessories such as residual oil treatment, hydrogen production, incinerator, analytical test, waste water treatment, water, flare stack, fuel, air/nitrogen, storage tanks, exhaust gas desulphurization, package boiler, pure water, road and underground piping were completed.

20866 (NEDOJ—8701, pp 51-62) **Development of brown coal liquefaction technology. Supporting study for operation of pilot plant.** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A14. Order Number DE88770075/JAW.

In FY 1986 NEDO Annual Report (Part 1).

A 50 t/d-pilot plant is developed aiming at developing the liquefaction plant of Victorian brown coal in Australia under a R/D agreement made between Japan and Australia. The purpose of this study is to make the supporting study by the PDU and others to acquire the data for the operational guideline and data analysis required for the development. The findings obtained in FY 1986 were as followed: (1) Study on the optimum operational conditions and characteristics of the reactor: the operation of pilot plant was supported; the prevention of trouble was dealt with; the process was evaluated; and the optimization of process was investigated; (2) Prevention of operational troubles: the abnormal reaction in the primary and secondary hydrogenations and the measures to counter the abnormal reaction were investigated; and (3) Relationship of the evaluation and analysis of liquefied oil with the operational conditions of the secondary hydrogenation process: the test of analysis of liquefied oil and the experiment of hydrogenation using commercially available catalysts were made. (9 figs, 2 tabs)

20867 (NEDOJ—8701, pp 63-68) **Development of brown coal liquefaction technology. Construction and operation of pilot plant (Development of 50 t/d-pilot plant).** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A14. Order Number DE88770075/JAW.

In FY 1986 NEDO Annual Report (Part 1).

The purpose of this study is to construct a 50 t/d-pilot plant for developing the liquefaction technology of Victorian brown coal in Australia under a R/D agreement made between Japan and australia, to demonstrate the performance and reliability of the brown coal liquefaction process by the two-stage hydrogenation process and to acquire the technical data for the construction of a commercial plant. The studies executed in FY 1986 are as follows: the detailed design of the second phase facilities including dehydration, deashing and secondary hydrogenation and of the maintenance and improvement works were made; the machines for the second phase facilities were manufactured and installed; the trial operation of the first phase facilities was made as expected though many troubles were encountered; the continuous operation was successfully made for 19 days or 456.7 hours; the soundness of the facilities was confirmed; and the operation technique was established.

20868 (NEDOJ—8701, pp 69-73) **Experimental basis development of equipment for coal liquefaction plant. Development of materials for accessories (Study by in-plant testing).** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A14. Order Number DE88770075/JAW.

In FY 1986 NEDO Annual Report (Part 1).

The purpose of this study is to acquire the data for establishing the measures to counter corrosion, erosion and abrasion of the materials of the components such as high-pressure valves, check valves and high-temperature and high-pressure piping for the equipment required for designing and constructing the control valve varies according to the adjustment at the installation. The degree of pitting is lowered from the welding metal heated by the highest temperature through the part adjacent to the welding to the base metal heated by the lowest temperature in the heating coil of coal slurry. The welding metal was pitted selectively in some heating coils. The inside of the outlet pipe of the liquefied oil from the high-temperature separating vessel was eroded in a wavy pattern and the back side of the butt welding was severely eroded. The restricted orifice was worn out up to the inner diameter of pipe. Some pitting was observed in the piping to and from the desulphurization tower. The material samples of the reactor and oil scrubber of the 2.4 t/d-PDU were submitted to the tensile, impact and destructive tests.

20869 (NEDOJ—8701, pp 74-77) **Experimental basis development of equipment for coal liquefaction plant. Development of materials for accessories (Study on corrosion resistance).** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A14. Order Number DE88770075/JAW.

In FY 1986 NEDO Annual Report (Part 1).

This paper presents the results of the development of materials for the accessories in the coal liquefaction plant, especially the corrosion resistance, investigated in FY 1986. The test specimens put in various parts of the 1 t/d-plant in 1982 were taken out in October, 1986. The corroded volume in the test specimens increased compared with that observed in 1985. The stress corrosion in stainless steel also increased and newly developed cracking on the test specimen of SUS 304 and the like in the regeneration tower in the hydrogenation process was observed. Anything abnormal was not observed in the piping sampled in October, 1986, from the main parts in the plant. The increase of corrosion may be caused by increasing of concentration of chlorine ion derived from the different ranks of coal and using sulphur in the hydrogenation section for regenerating the catalyst. Since the stress corrosion cracking by H_2S-Cl^- is crucial, stainless steel containing 20% or more of Ni is suitable for the part on which water is condensed at a medium-to-high temperature.(2 figs)

20870 (NEDOJ—8701, pp 78-80) **Experimental basis development of equipment and materials for coal liquefaction plant (Development of centrifugal slurry pump for liquefaction plant.** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A14. Order Number DE88770075/JAW.

In FY 1986 NEDO Annual Report (Part 1).

This paper presents the findings of the development of the coal slurry transfer centrifugal slurry pump in FY 1986. The abrasion-test runs of three single-stage pumps were made for 150 hours at the rates of 4/4Q, 3/4Q and 2/4Q (Q: design flow rate), respectively. The higher the flow rate at the inlet of impeller is, the harsher the abrasion is. Several pin-shaped marks near the inlet of impeller were observed at the flow rate of 4/4Q. Many pin-shaped

marks were observed there at the flow rate of 3/4Q and much more pin-shaped marks and striped marks starting from those marks were observed at the flow rate of 2/4Q. The worn amount of the impeller at the flow rate of 2/4A was the least in general and those at the flow rates of 3/4Q and 4/4Q were almost the same as each other. The worn amount was not increased even at the region of partial flow rate. The abrasion can be reduced by contraction if the shape of inlet of sealing device is appropriate.

20871 (NEDOJ—8701, pp 81-85) **Survey for selecting the ranks of coal. Survey of ranks of coal.** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A14. Order Number DE88770075/JAW.

In FY 1986 NEDO Annual Report (Part 1).

This paper presents the findings on the survey of the ranks of coal for coal liquefaction in FY 1986. The coal used for the test includes 47 ranks of brown, subbituminous and bituminous coals mined in the U.S., Canada and Australia. The coal characteristics were examined and the coal liquefaction characteristics were tested. The geological survey of the Canadian subbituminous coal was made on the spot. There is a close correlation in the coal ranging from brown coal to high-volatility bituminous coal among the oil yield, coal rank and chemical composition. The yield of liquefied oil can be estimated from the content of volatile matter, heat value, H/C and O/C ratios in the number of atom, content of maceral group and vitrinite reflectance. A simplified testing method for evaluating the oil yield which can test two or more samples at a time was established. The liquefaction characteristic value and that under the standard conditions correlate with each other. The potential of liquefaction can be effectively evaluated by the simplified testing method.(1 fig, 1 tab)

20872 (NEDOJ—8701, pp 86-87) **Survey for selecting the ranks of coal. Examination of coal for pilot plant of bituminous coal liquefaction.** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A14. Order Number DE88770075/JAW.

In FY 1986 NEDO Annual Report (Part 1).

The potential coal as the feed stock for the pilot plant of bituminous coal liquefaction was examined. The reserves, production and quality of the coal in the class of low rank of coalification in plains district, Alberta, Canada, was examined. 99.5% of the production is supplied to the power generation plant near the pit. The mining field of coal is owned by the utility which gives a contract to a coal mining company to mine coal. The mining field is not thoroughly furnished with the loading facilities because the coal is consumed on the spot. A coal chain system for the coal loaded on wagons is installed at any loading and unloading places including harbour. It is necessary to pay attention not to cause the spontaneous ignition during the transportation. The reserves, production and transportation of the Wyoming coal in Powder River Basin District in the western part of the U.S. were examined. There is an enormous amount of subbituminous coal reserves in the District and mass-production is carried out by open-pit coal mining method. The property analysis of the sample coal is required. Care must be taken not to cause the spontaneous ignition and raising the coal dust during the transportation because the coal has not been sent abroad.

20873 (NEDOJ—8701, pp 88-89) **Survey for selecting the ranks of coal. Performance test of liquefaction of Chinese coal.** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A14. Order Number DE88770075/JAW.

In FY 1986 NEDO Annual Report (Part 1).

This paper outlines the performance test of liquefaction of Chinese coal. The characteristics of three ranks of Chinese coal were examined by the elementary and technical analyses and sink-float method in FY 1980. The analyses and liquefaction test were continued and a small continuous test plant was manufactured under an agreement made with the Chinese Research Institute of Coal Science for promoting the joint research in FY 1981. The test plant was installed in Beijing and the test operation and overall operation were carried out in FY 1982. The liquefaction characteristics of Chinese coal such as Beisu coal and others and the plant characteristics were determined and the researchers were trained to get skilled in operating the plant in FY 1983. The circulation plant of produced gas was installed in FY 1984 and the circulation plant of solvent was installed in FY 1985. The data of liquefaction characteristics of four ranks of coal were acquired in FY 1986 by continuously operating the test plant varying the conditions from the standard conditions of the temperature of 450°C, the pressure of 250 kg/cm^{2}G and the retention time of 60 minutes.

20874 (NEDOJ—8701, pp 90-104) **Uses and refining technology of coal-derived liquid product. Development of techniques of upgrading of coal-derived liquid and mixing with petroleum.** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A14. Order Number DE88770075/JAW.

In FY 1986 NEDO Annual Report (Part 1).

This paper presents the findings in FY 1986 on the technical development of purification of coal-derived liquid and uses of product. A Ni-Mo catalyst was appropriate for the hydrogenation of naphtha produced from the solvent hydrogenation process in the coal liquefaction plant. The content of nitrogen remaining in the product hydrogenated in the existing refinery was decreased below the target of 1 ppm. Although the fraction of kerosene refined from the hydrogenated oil alone did not show the sufficiently high smoke point, the kerosene with a smoke point as high as 23 or more was obtained by purifying that naphtha together with petroleum fraction. The long run test for additional 700 hours or more is required for the service-life test of catalyst. The kerosene produced from the coal-derived liquid was able to be used without any troubles for the oil fan-heater for 1000 hours or longer, but the kerosene purified from the hydrogenated oil alone caused the insufficient combustion due to the tar deposited on the wick of the kerosene heater. The smoke point of kerosene was satisfied by selecting the proper conditions for the hydrogenation of the mixture of middle distillate of hydrogenated oil and the petroleum fraction. The sulphur contained in the heavier middle distillate is relatively easily removed by hydrogenation using the Ni-Mo catalyst, though the nitrogen is hardly removed. (20 figs, 6 tabs)

20875 (NEDOJ—8701, pp 105-109) **Development and operation of evaluating procedure of coal liquefaction process. Operation of liquefaction simulator.** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A14. Order Number DE88770075/JAW.

In FY 1986 NEDO Annual Report (Part 1).

This paper presents the maintenance and improvement in the operation of a coal liquefaction process simulator (ALPS). The simulator was adjusted by reflecting the data of process operation and the result of recent experiments of liquefaction in the built-in parameters to enhance the applicability to the NEDOL process. The parameters include the estimated physical properties, structure of coal, hydrogen consumption, reaction and yield. The parameters are adjusted to improve the accuracy so that the whole system is consistent. The function of ALPS was improved to support the user by adding the temperature correction term for specific heat of coal, increasing the function estimating the physical properties in liquid-gas equilibrium, adding the function treating a simple sulphur in the liquefaction reactor and adding the reformed solvent-hydrogenation reaction formula. The concept of calculation of heat balance and the conditions of steadily circulating solvent in the operation of simulator were investigated and the problems, utility consumptions and cost calculation in the production of hydrogen from the residual product were illustrated with examples.

20876 (NEDOJ—8701, pp 110-118) **Development and operation of evaluating procedure of coal liquefaction process. Data collection of coal liquefaction process and its processing system.** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A14. Order Number DE88770075/JAW.

In FY 1986 NEDO Annual Report (Part 1).

The information system of coal liquefaction technology, the data collection from the 250 t/d pilot plant and the process supporting unit, and its processing system have been developed to effectively utilize in the future. The preliminary survey and investigation were performed in FY 1986. The rating of data base was made based on the analysis of current state, the demands from the persons concerned and the opinions of people of learning and experience, and the data base was classified into four groups: the general information data such as the data from the past experiments on coal liquefaction, analytical results, ranks of coal and coal reserves; the fundamental data such as operational and analytical data from the

experiment; the data for analysis such as the results analyzed by the reaction constants and the peripheral softwares for sizing of equipment; and the engineering data such as the design package for demonstration and commercialization. (4 figs, 1 tab)

20877 (NEDOJ—8701, pp 119-121) **Development of environmental pollution control technology. Environmental safety test of coal-derived liquid.** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A14. Order Number DE88770075/JAW.

In FY 1986 NEDO Annual Report (Part 1).

FY 1986 is the third year of the Phase I of environmental safety test of coal-derived liquid and the test of the liquid derived from bituminous coal by PDU has been almost completed in this year. The median lethal dose of low-and medium-boiling liquids is as high as 2 to 5 mg/l and accordingly the acute toxicity is low. The medium-boiling liquid shows no sensitization to the skin by the repeated application test, while the high-boiling liquid shows a weak one. The low-, medium-and high-boiling liquids cause the skin intense irritations and liver diseases. The mutagenicity of chromosome by the high-boiling liquid is negative. The coal-derived liquid is hard-biodegradable. The degree of biological accumulation is intermediate. The contents of phenols and cresols in the low-boiling liquid is 12% and those in the high-boiling liquid is 0.21%, while the content of benzpyrene in the low-boiling liquid is 0.21 ppm and that in the high-boiling liquid is 270 ppm. Since the data of the coal-derived liquid by PDU is different in the distillation conditions from those of the coal-derived liquid from the pilot plantby the NEDOL process, the former data are preliminary.

20878 (NEDOJ—8701, pp 122-130) **Development of gasification technology producing high BTU gas. Study by dismantling 7000 Nm^3/d plant.** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A14. Order Number DE88770075/JAW.

In FY 1986 NEDO Annual Report (Part 1).

Abrasion and corrosion in the coal gasification plant producing high BTU gas were investigated by dismantling the 7000 Nm^3/d plant. Local abrasion was observed in the grinder in the coal pretreating process. The worn part on the material in the wet feeding process can be repaired by thermal spraying. In the gasification, cooling and heat recovery processes, the surface corrosion and internal erosion of the reinforcing material for the refractory castable in the gasification furnace and the intergranular corrosion by the high-temperature sulphurization in various valves were observed. Intense pitting corrosion was observed on the inner surface of nozzles heated up to a temperature of 200 to 300°C. The tubes of fluidized-bed cooler were corroded by sulphurization. The shell, end plate and nozzles of the first refining column in the water-oil separating process were pitted. All surfaces of the middle and bottom sections of amine regenerating column in the gas purification process were eroded and the reboiler was pitted. The dismantling works of the plant were started in September, 1986, and completed in March, 1987. (1 fig)

20879 (NEDOJ—8701, pp 131-133) **Development of coal gasification combined cycle power generation plant.** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A14. Order Number DE88770075/JAW.

In FY 1986 NEDO Annual Report (Part 1).

The purpose of this study is to develop the coal gasification producing clean low BTU gas fuel for the gas turbine, the purification process of the gas produced and the economical combined power generation system using the purified gas. This study has been continuously performed since 1980 to develop the basic design of a 100 MW combined cycle power generation plant using the gas derived from the gasification process treating 1000 tons of Taiheiyo coal per day. The cold model operation of a gasifier was carried out. The works performed in FY 1986 are as follows: the plan of basic design including the pressurized fluidized-bed gasification facilities, dry desulphurization-precise dust removing equipment, power generating facilities and start-up and shut-down procedures of plant was made; the durability of air-tight valve, flash transporting characteristics of char by an injector and the control method of circulating char by a L-valve were confirmed; and the data for scaling-up the equipment was obtained by testing a large fluidized-bed.

20880 (NEDOJ—8701, pp 134-138) **Development of entrainment coal gasification power plant. Study on element of pilot plant.** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A14. Order Number DE88770075/JAW.

In FY 1986 NEDO Annual Report (Part 1).

For development of an entrainment coal gasification power plant, the essential elements of the plant were tested, using a model. Further, a 200 tons/year pilot plant is to be built for the succeeding four years. In 1986, the first year of the project, test apparatus such as a continuous power supply unit, an automatic combustible-power burner, a high temperature char recovery unit, and so forth were designed and fabricated. By using a 2 tons / day test plant, gasification of prospect coals, and anti-corrosion of the plant to the practical gas were tested. For the dry desulfurization unit and the dry dust protective unit, test apparatus such as a cold model, etc. were designed and fabricated. For the gas turbine and gasification furnace system, a calculation model for the operation characteristics was prepared. For simulation of the combined power plant, data for characteristics analysis of each unit were collected. Basic design of the main units in the final pilot plant was conducted. (2 figs)

20881 (NEDOJ—8701, pp 139-144) **Development of coal-based hydrogen production technology. Design and construction of pilot plant.** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A14. Order Number DE88770075/JAW.

In FY 1986 NEDO Annual Report (Part 1).

The pilot plant of entrained bed high-temperature coal gasification is constructed and operated to establish the low-cost mass production technology of hydrogen from coal. This study is based on the componental research for multi-purpose coal gasification performed from 1980 to 1985. The construction of pilot plant will be completed by 1990. The main works performed in FY 1986 are as follows: the basic specifications such as coal feeding system, type of gasifier, throughput of coal (beginning with 20 t/d) and pressure and temperature in gasifier were decided; the process flow system, lay-out, main facilities in each process and type and capacity of equipment were decided; the facilities in the processes of coal preparation, water scrubbing of gas, flaring of product gas and ash treatment were designed in detail and manufactured; the plant site was measured and surveyed; and the ground of part of the site was leveled. (2 figs)

20882 (NEDOJ—8701, pp 145-149) **Development of coal-based production technology. Supporting study to pilot plant (Study by small equipment).** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A14. Order Number DE88770075/JAW.

In FY 1986 NEDO Annual Report (Part 1).

The purpose of this study is to investigate and confirm the operation control method of gasifier by the model testing in the supporting study to the pilot plant of manufacturing hydrogen from coal. This study has been made since 1983. The flows of gas and particles in the revolving type gasifier have been determined and the self-heating type slag-tapped hole and the burner have been developed so far. In FY 1986, the infrared and visible images of the slag flowing near the tapped hole were taken and the automatic monitoring method of the situation of flowing slag was studied by processing the images to confirm the viability. Using the combined test equipment of the gasifier and the coal feeder, the amount of oxygen fed to the burner of gasifier was investigated to determine the conditions corresponding to various ranks of coal.(3 figs)

20883 (NEDOJ—8701, pp 150-156) **Development of coal-based production technology. Supporting study to pilot plant (Component material for plant).** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A14. Order Number DE88770075/JAW.

In FY 1986 NEDO Annual Report (Part 1).

The components of gasifier such as refractory, ceramic part and metallic material were developed and evaluated to support the design program of the manufacturing plant of hydrogen from coal. This study has been made since 1983. The findings in FY 1986 are as follows: 1) Refractory: the manufacturing process of high chromia-and picrochromite-based refractories were developed; the high resistance to slagging of these refractories was determined under the simulated environmental condition, and the thermal stabilities of

dimension and strength were also determined; 2) Ceramic parts: the high-purity picrochromite thermocouple-protecting take and SiC-coated valves were manufactured on an experimental basis and the viability was confirmed; and 3) Metallic material: the corrosion test was made in the simulated atmosphere and the corrosion potential of the atmosphere at various temperatures was evaluated. The candidate materials for the components of gasifier were summarized from those findings. (3 figs)

20884 **(NEDOJ—8701) FY 1986 NEDO Annual Report (Part 1).** (New Energy Development Organization, Tokyo (Japan)). Sep 1987. 321p. (In Japanese). NTIS (US Sales Only), PC A14. Order Number DE88770075/JAW.

Articles in NEDOJ—8701 have been entered individually into EDB and ERA. (LTN)

20885 **(ORNL/TM—10686/V1) The RAMS [Research and Development Analysis Modeling System] coal model: Volume 1, Model overview.** Reister, D.B.; Conopask, J.V.; Mihlmester, P.E. (Oak Ridge National Lab., TN (USA)). Feb 1988. Contract AC05-84OR21400. 29p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006043/JAW.

The RAMS coal model was developed to aid the planning functions of the Office of Fossil Energy of the Department of Energy. The model was designed to simulate the market penetration of processes that use coal to produce liquid fuels. To simulate market penetration, we assume that the least cost process will have the largest share of the market. To evaluate the future income and costs for a process, we need to estimate the prices of all of the inputs and outputs for all of the coal processes and for all of the competing processes. After a literature review, we identified 26 types of energy, by-products, and factors of production that are potential inputs or outputs for a process. The coal model simulates the supply and demand for the 26 types of goods. The coal model input-output (I to O) structure has 13 sectors to produce the first 24 goods (the last 2 factors, labor and capital, are exogenous inputs). The first 10 sectors produce the first 10 goods, which are either primary or secondary forms of energy. Sector 11, the liquid fuels sector, produces refined petroleum products and by-products, the goods from 11 to 23. Sector 12 produces good 24, materials. The final sector, sector 13, is the trade sector. This report provides an overview of the RAMS coal model. After an introduction to the RAMS family of models, we discuss some of the key design issues for the coal model. To demonstrate the flexibility of the model, we adjusted the parameters and input variables of the model in an attempt to reproduce the base case scenario published in the most recent National Energy Policy Plan (NEPP). The results demonstrated that the model can create a scenario that is quite similar to the NEPP scenario. 8 refs., 7 figs.

20886 **(ORNL/TM—10686/V2) The RAMS [Research and Development Analysis Modeling System] coal model: Volume 2, User's guide.** Reister, D.B.; Conopask, J.V.; Mihlmester, P.E. (Oak Ridge National Lab., TN (USA)). Feb 1988. Contract AC05-84OR21400. 62p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88006042/JAW.

The RAMS coal model was developed to aid the planning functions of the Office of Fossil Energy of the Department of Energy. The model was designed to simulate the market penetration of processes that use coal to produce liquid fuels. To simulate market penetration, we assume that the least cost process will have the largest share of the market. To evaluate the future income and costs for a process, we need to estimate the prices of all of the inputs and outputs for all of the coal processes and for all of the competing processes. After a literature review, we identified 26 types of energy, by-products, and factors of production that are potential inputs or outputs for a process. The coal model simulates the supply and demand for the 26 types of goods. The coal model input-output (I to O) structure has 13 sectors to produce the first 24 goods (the last 2 factors, labor and capital, are exogenous inputs). The first 10 sectors produce the first 10 goods, which are either primary or secondary forms of energy. Sector 11, the liquid fuels sector, produces refined petroleum products and by-products, the goods from 11 to 23. Sector 12 produces good 24, materials. The final sector, sector 13, is the trade sector. This report is a user's guide for the RAMS coal model. After a discussion of how to install and operate the model, the report provides a guided tour of the five input data sets and the six output data sets. One of the input data sets can be edited using LOTUS 1-2-3. The model has a menu-driven editor that displays graphical output for all of the variables in the model. 8 tabs.

20887 **(ORNL/TM—10686/V3) The RAMS [Research and Development Analysis Modeling System] coal model: Volume 3, Model description.** Reister, D.B.; Conopask, J.V.; Mihlmester, P.E. (Oak Ridge National Lab., TN (USA)). Feb 1988. Contract AC05-84OR21400. 44p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88006041/JAW.

The RAMS coal model was developed to aid the planning functions of the Office of Fossil Energy of the Department of Energy. The model was designed to simulate the market penetration of processes that use coal to produce liquid fuels. To simulate market penetration, we assume that the least cost process will have the largest share of the market. To evaluate the future income and costs for a process, we need to estimate the prices of all of the inputs and outputs for all of the coal processes and for all of the competing processes. After a literature review, we identified 26 types of energy, by-products, and factors of production that are potential inputs or outputs for a process. The coal model simulates the supply and demand for the 26 types of goods. The coal model input-output (I-O) structure has 13 sectors to produce the first 24 goods (the last 2 factors, labor and capital, are exogenous inputs). The first 10 sectors produce the first 10 goods, which are either primary or secondary forms of energy. Sector 11, the liquid fuels sector, produces refined petroleum products and by-products, the goods from 11 to 23. Sector 12 produces good 24, materials. The final sector, sector 13, is the trade sector. The overall architecture of RAMSCOAL features a core model and a family of satellite models. The core model is a general equilibrium model of the supply and demand for the 23 types of energy and by-products. Given I-O coefficients for each of the first 12 sectors and the levels of imports and exports, the core model balances supply and demand and forecasts prices and quantity of production for the 23 types of energy and by-products. The I-O coefficients for each sector are forecast by the satellite models. This report presents the equations for the core model and for all of the existing satellite models. 7 refs., 1 fig., 1 tab.

20888 **(PB—88-143367/XAB) Environmental-Monitoring Plan for the Dow Syngas Project. Quarterly report: second quarter, 1985, Report for April-June 1985.** Carville, D.B. (Louisiana Gasification Technology, Inc., Plaquemine (USA)). 31 Aug 1985. 183p. NTIS, PC A09/MF A01.

See also PB—88-127212.

The Energy Security Act of 1980 established a program to provide financial assistance to private industry in the construction and operation of commercial-scale synthetic-fuels plants. The Dow Syngas Project design has a high-temperature entrained-flow slagging type gasifier, scheduled to begin operating in 1987. Dow agreed to comply with existing environmental regulations and to develop an Environmental Monitoring Plan (EMP) incorporating supplemental monitoring in areas of potential environmental and health concern, relative to synthetic-fuels facilities. The two phases of monitoring in the EMP will test parameters of interest in air, water, and solid waste for evaluating plant operations and for establishing a data base of information for resolving environmental uncertainties relative to replication of synthetic fuels plants. This Quarterly Report describes progress in construction and process design engineering, source monitoring, ambient monitoring, quality assurance/quality control and monitoring problems and recommended changes.

20889 **(PB—88-143375/XAB) Environmental-Monitoring Plan for the Dow Syngas Project. Quarterly report: fourth quarter, 1985. Report for October-December 1985.** Carville, D.B. (Louisiana Gasification Technology, Inc., Plaquemine (USA)). 28 Feb 1986. 167p. NTIS, PC A08/MF A01.

See also quarterly rept. April-June 1985, PB—88-143367.

The Energy Security Act of 1980 established a program to provide financial assistance to private industry in the construction and operation of commercial-scale synthetic-fuels plants. The Dow Syngas Project design has a high-temperature entrained-flow slag-

ging type gasifier, scheduled to begin operating in 1987. Dow agreed to comply with existing environmental regulations and to develop an Environmental Monitoring Plan (EMP) incorporating supplemental monitoring in areas of potential environmental and health concern, relative to synthetic-fuels facilities. The two phases of monitoring in the EMP will test parameters of interest in air, water and solid waste for evaluating plant operations and for establishing a data base of information for resolving environmental uncertainties relative to replication of synthetic-fuels plants. Monitoring information is submitted in quarterly and annual reports. This quarterly report describes project construction progress, applications for operating permits, EMP implementation activities for source and ambient monitoring, and quality assurance/quality control results.

20890 **(PB—88-143383/XAB) Environmental-Monitoring Plan for the Dow Syngas Project. Annual report: 1985. Report for 29 March-31 December 1985.** Carville, D.B. (Louisiana Gasification Technology, Inc., Plaquemine (USA)). 27 Jun 1986. 77p. NTIS, PC A05/MF A01.

See also report dated February 1986, PB—88-143375.

The Energy Security Act of 1980 established a program to provide financial assistance to private industry in the construction and operation of commercial-scale synthetic-fuels plants. The Dow Syngas Project design has a high-temperature entrained-flow slagging type gasifier, scheduled to begin operating in 1987. Dow agreed to comply with existing environmental regulations and to develop an Environmental Monitoring Plan (EMP) incorporating supplemental monitoring in areas of potential environmental and health concern, relative to synthetic-fuels facilities. The two phases of monitoring in the EMP will test parameters of interest in air, water, and solid waste for evaluating plant operations and for establishing a data base of information for resolving environmental uncertainties relative to replication of synthetic fuels plants. Monitoring activities during 1985 are summarized in this report. The preconstruction monitoring was completed during 1985, and portions of the preconstruction monitoring were conducted.

20891 **(PB—88-143904/XAB) Cool Water Coal Gasification Program: environmental monitoring plan. Quarterly report, July 1 through September 30, 1984.** (Cool Water Coal Gasification Program, Daggett, CA (USA)). 31 Dec 1984. 212p. NTIS, PC A10/MF A01.

See also PB—88-143912, and PB—88-127592.

The Energy Security Act of 1980 established a program to provide financial assistance to private industry in the construction and operation of commercial-scale synthetic-fuels plants. The Cool Water Coal Gasification Program is one of the four projects awarded financial assistance. This Program agreed to comply with existing environmental-monitoring regulations and to develop an Environmental Monitoring Plan incorporating supplemental monitoring in the areas of water, air, solid waste, worker health and safety, and socio-economic impacts during the period 1984-1989. As the first commercial-scale integrated gasification combined-cycle plant for generating energy from coal, the plant is designed to process a variety of coals with no liquid discharge, produce non-hazardous solid wastes, and produce very few air emissions. Monitoring data are to provide an information base for evaluating plant operations and for establishing information on environmental uncertainties associated with replication of synthetic-fuels facilities. This Quarterly Report presents activities associated with the Commissioning Phase during the third quarter of 1984, including implementation of compliance monitoring, validation of monitoring procedures, and personnel training.

20892 **(PB—88-143912/XAB) Cool Water Coal Gasification Program: environmental monitoring plan. Quarterly report, January 1 through March 31, 1985.** (Cool Water Coal Gasification Program, Daggett, CA (USA)). 28 Jun 1985. 483p. NTIS, PC A21.

Also pub. as Radian Corp., Austin, TX. rept. No. DCN-85-218-032-32. See also PB—88-143920; Portions of this document are not fully legible.

The Energy Security Act of 1980 established a program to provide financial assistance to private industry in the construction and operation of commercial-scale synthetic-fuels plants. The Cool Water Coal Gasification Program is one of the four projects awarded financial assistance. This Program agreed to comply with existing environmental-monitoring regulations and to develop an Environmental Monitoring Plan incorporating supplemental monitoring in the areas of water, air, solid waste, worker health and safety, and socio-economic impacts during the period 1984-1989. As the first commercial-scale integrated gasification combined-cycle plant for generating energy from coal, the plant is designed to process a variety of coals with no liquid discharge, produce non-hazardous solid wastes, and produce very few air emissions. Monitoring data are to provide an information base for evaluating plant operations and for establishing information on environmental uncertainties associated with replication of synthetic-fuels facilities. This Quarterly Report presents activities associated with commissioning the quench gasifier, compliance monitoring, and ambient-air monitoring.

20893 **(PB—88-143920/XAB) Cool Water Coal Gasification Program: environmental monitoring plan. Quarterly report, April 1 through June 30, 1985.** (Cool Water Coal Gasification Program, Daggett, CA (USA)). 30 Sep 1985. 259p. NTIS, PC A12.

Also pub. as Radian Corp., Austin, TX. rept. No. DCN-85-218-032-49. See also PB—88-143938; Portions of this document are not fully legible.

The Energy Security Act of 1980 established a program to provide financial assistance to private industry in the construction and operation of commercial-scale synthetic-fuels plants. The Cool Water Coal Gasification Program is one of the four projects awarded financial assistance. This Program agreed to comply with existing environmental-monitoring regulations and to develop an Environmental Monitoring Plan incorporating supplemental monitoring in the areas of water, air, solid waste, worker health and safety, and socio-economic impacts during the period 1984-1989. As the first commercial-scale integrated gasification combined-cycle plant for generating energy from coal, the plant is designed to process a variety of coals with no liquid discharge, produce non-hazardous solid wastes, and produce very few air emissions. Monitoring data are to provide an information base for evaluating plant operations and for establishing information on environmental uncertainties associated with replication of synthetic-fuels facilities. This Quarterly Report describes activities associated with the Comprehensive Phase of the monitoring program, including Compliance Monitoring, emission tests of the incinerator stack and cooling tower, and ambient-air monitoring.

20894 **(PB—88-143938/XAB) Cool Water Coal Gasification Program: environmental monitoring plan. Quarterly report, July 1 through September 30, 1985.** (Cool Water Coal Gasification Program, Daggett, CA (USA)). 31 Dec 1985. 103p. NTIS, PC A06.

Also pub. as Radian Corp., Austin, TX. rept. No. DCN-85-218-032-63. See also PB—88-143946; Portions of this document are not fully legible.

The Energy Security Act of 1980 established a program to provide financial assistance to private industry in the construction and operation of commercial-scale synthetic-fuels plants. The Cool Water Coal Gasification Program is one of the four projects awarded financial assistance. This Program agreed to comply with existing environmental-monitoring regulations and to develop an Environmental Monitoring Plan incorporating supplemental monitoring in the areas of water, air, solid waste, worker health and safety, and socio-economic impacts during the period 1984-1989. As the first commercial-scale integrated gasification combined-cycle plant for generating energy from coal, the plant is designed to process a variety of coals with no liquid discharge, produce non-hazardous solid wastes, and produce very few air emissions. Monitoring data are to provide an information base for evaluating plant operations and for establishing information on environmental uncertainties associated with replication of synthetic-fuels facilities. This Quarterly Report describes progress in environmental sampling and analysis, including samples obtained from ambient-air analytical results, source monitoring to meet compliance, and supplemental Indicator Phase requirements. Plant operations include 1500 hours of operation at 65% capacity.

20895 **(PB—88-143946/XAB) Cool Water Coal Gasification Program: environmental monitoring plan - monitoring review committee meeting report, June 20-21, 1985, Daggett, California.** (Cool Water Coal Gasification Program, Daggett, CA (USA)). 25 Oct 1985. 108p. NTIS, PC A06.

Also pub. as Radian Corp., Austin, TX. rept. No. DCN-85-218-032-54. See also PB—88-143953; Portions of this document are not fully legible.

The Energy Security Act of 1980 established a program to provide financial assistance to private industry in the construction and operation of commercial-scale synthetic-fuels plants. The Cool Water Coal Gasification Program is one of the four projects awarded financial assistance. This Program agreed to comply with existing environmental-monitoring regulations and to develop an Environmental Monitoring Plan incorporating supplemental monitoring in the areas of water, air, solid waste, worker health and safety, and socio-economic impacts during the period 1984-1989. As the first commercial-scale integrated gasification combined-cycle plant for generating energy from coal, the plant is designed to process a variety of coals with no liquid discharge, produce non-hazardous solid wastes, and produce very few air emissions. Monitoring data are to provide an information base for evaluating plant operations and for establishing information on environmental uncertainties associated with replication of synthetic-fuels facilities. The Monitoring Review Committee members review all available environmental data and convene at least once a year to discuss trends of environmental and health concern and to recommend revisions in monitoring efforts to obtain the most-useful information for answering environmental questions associated with commercial synfuels facilities.

20896 **(PB—88-143953/XAB) Cool Water Coal Gasification Program: environmental monitoring plan comprehensive phase final report. Volume 1. Technical report. Volume 2. Appendix A - analytical results. Volume 3. Appendix B - quality assurance/quality control. Volume 4. Appendix C - sampling and analytical methods. Appendix D - ambient air monitoring data. Volume 5. Appendix E - stack emissions monitoring.** (Cool Water Coal Gasification Program, Daggett, CA (USA)). 9 Sep 1986. 1190p. NTIS, PC A99.

Also pub. as Radian Corp., Austin, TX. rept. No. DCN-86-218-042-33. See also PB—88-143961; Portions of this document are not fully legible.

The Energy Security Act of 1980 established a program to provide financial assistance to private industry in the construction and operation of commercial-scale synthetic-fuels plants. The Cool Water Coal Gasification Program is one of the four projects awarded financial assistance. This Program agreed to comply with existing environmental-monitoring regulations and to develop an Environmental Monitoring Plan incorporating supplemental monitoring in the areas of water, air, solid waste, worker health and safety, and socio-economic impacts during the period 1984-1989. As the first commercial-scale integrated gasification combined-cycle plant for generating energy from coal, the plant is designed to process a variety of coals with no liquid discharge, produce non-hazardous solid wastes, and produce very few air emissions. Monitoring data are to provide an information base for evaluating plant operations and for establishing information on environmental uncertainties associated with replication of synthetic-fuels facilities. Comprehensive Phase monitoring was conducted after the Commissioning Phase and start-up of plant operations was completed during February, 1985. Results include source monitoring, pollution-control performance, ambient-air monitoring, compliance monitoring, quality assurance/quality control, and problems associated with plant operations.

20897 **(PB—88-143961/XAB) Cool Water Coal Gasification Program: environmental monitoring plan. Annual report, July 1 through December 31, 1984.** (Cool Water Coal Gasification Program, Daggett, CA (USA)). 29 Mar 1985. 385p. NTIS, PC A17.

Also pub. as Radian Corp., Austin, TX. rept. No. DCN-85-218-032-20. See also PB—88-143979; Portions of this document are not fully legible.

The Energy Security Act of 1980 established a program to provide financial assistance to private industry in the construction and operation of commercial-scale synthetic-fuels plants. The Cool Water Coal Gasification Program is one of the four projects awarded financial assistance. This Program agreed to comply with existing environmental-monitoring regulations and to develop an Environmental Monitoring Plan incorporating supplemental monitoring in the areas of water, air, solid waste, worker health and safety, and socio-economic impacts during the period 1984-1989. As the first commercial-scale integrated gasification combined-cycle plant for generating energy from coal, the plant is designed to process a variety of coals with no liquid discharge, produce non-hazardous solid wastes, and produce very few air emissions. Monitoring data are to provide an information base for evaluating plant operations and for establishing information on environmental uncertainties associated with replication of synthetic-fuels facilities.

20898 **(PB—88-143979/XAB) Cool Water Coal Gasification Program: environmental monitoring plan. Occupational health and safety surveillance, 1985 annual report.** (Cool Water Coal Gasification Program, Daggett, CA (USA)). 1 Oct 1986. 54p. NTIS, PC A04/MF A01.

See also PB—88-143961.

The Energy Security Act of 1980 established a program to provide financial assistance to private industry in the construction and operation of commercial-scale synthetic-fuels plants. The Cool Water Coal Gasification Program is one of the four projects awarded financial assistance. This Program agreed to comply with existing environmental-monitoring regulations and to develop an Environmental Monitoring Plan incorporating supplemental monitoring in the areas of water, air, solid waste, worker health and safety, and socio-economic impacts during the period 1984-1989. As the first commercial-scale integrated gasification combined-cycle plant for generating energy from coal, the plant is designed to process a variety of coals with no liquid discharge, produce non-hazardous solid wastes, and produce very few air emissions. Monitoring data are to provide an information base for evaluating plant operations and for establishing information on environmental uncertainties associated with replication of synthetic-fuels facilities. This report documents health and safety activities and issues at the Cool Water Program from June to December, 1985. A comprehensive health and safety-surveillance program is being implemented to meet all compliance and Program requirements.

20899 **(SRC—144) Low temperature lignite liquefaction.** Barnes, F. (Saskatchewan Research Council, Saskatoon (Canada)). Oct 1982. 38p. CANMET/TID, 55 Booth Street, Ottawa, Ontario, Canada K1A 0G1.

The potential of using a coal-oil slurry rather than a coal-water slurry to transport coal by pipeline appears feasible, but further research is required. In this paper one aspect of this procedure is examined - the possibility of using oil manufactured from the coal which is to be transported. The reaction temperature for lignite liquefaction was lowered to the 300 C to 400 C range (from 400 C-460 C which is commonly used) and the reaction time was extended several hours. It was determined that the reaction rate decreases with temperature and that a long retention time does not compensate for the conversion loss due to low temperature. Recommendations for further research are included. 5 refs.

20900 **(UCID—21339) Laboratory characterization of the spalling properties of the rock cores from the UCG [Underground Coal Gasification] test site near Porto Alegre in Brazil.** Tantekin, S.B.; Sperry, D.P.; Krantz, W.B.; Britten, J.A. (Colorado Univ., Boulder (USA). Dept. of Chemical Engineering; Lawrence Livermore National Lab., CA (USA)). 22 Feb 1988. Contract W-7405-ENG-48. 14p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006720/JAW.

One of the principal problems encountered in most of the Underground Coal Gasification (UCG) field tests conducted thus far has been excessive water influx. Spalling-enhanced-drying of coal and overburdens rock has been identified as the principal mechanism of water influx observed in the Hanna UCG field tests in Wyoming Spalling is defined as the chipping, fracturing and breaking off of small rock fragments from the cavity roof due to the combined action of mechanical loading and thermally induced stresses. Spalling is also responsibble for vertical cavity growth and a portion of the heat losses during UCG. A laboratory core characterization method has been developed to determine the spalling properties of overburden rock which are essential to make influx

and cavity geometry predictions for a prospective field test. In this study, the spalling properties of the representative rock cores from the UCG test site near Porto Alegre in Brazil have been determined using the laboratory core characterization test which utilizes the temperature-gradient-induced spalling hypothesis.

20901 **Changes in the chemical structure of coal during treatment with molten caustic.** Schmidt, C.E.; Makovsky, L.E.; Utz, B.R.; White, C.M.; Retcofsky, H.L. (USDOE Pittsburgh Energy Technology Center, PA (USA)). pp 443-446 of 1987 international conference on coal science. Moulijn, J.A.; Nater, K.A.; Chermin, H.A.G. (eds.). Amsterdam, Netherlands; Elsevier Science Publishers (1987). (CONF-871030—).

From International conference on coal science; Maastricht, Netherlands (26 Oct 1987).

Describes chemical reactions and changes in the chemical structure taking place during molten caustic treatment of coal to remove sulfur and ash. A coal extract was analysed before and after treatment with molten caustic to monitor the chemistry of organo-sulfur removal. The effect of reaction temperature on the coal structure was studied. Results show a large decrease in amount of sulfur compounds and changes in the aromaticity and H/C ratio. 5 refs.

20902 **Phase changes of pyrite embedded in coal.** Wert, C.A.; Tseng, B.H.; Ge, Y.P. (University of Illinois, Urbana (USA). Dept. of Materials Science and Engineering and Materials Research Laboratory). pp 455-458 of 1987 international conference on coal science. Moulijn, J.A.; Nater, K.A.; Chermin, H.A.G. (eds.). Amsterdam, Netherlands; Elsevier Science Publishers (1987). (CONF-871030—).

From International conference on coal science; Maastricht, Netherlands (26 Oct 1987).

Both pyritic and organic sulfur are lost from coal when heated above 400 C. The pyrite is altered to an oxide, with consequent loss of sulfur, either as sulfur-oxide or hydrogen-disulfide. Scanning electron microscopy and transmission electron microscopy have been used to study and determine whether any of the sulfur from decomposing sulfide enters the coal matrix as organic sulfur. 4 refs.

20903 **Vapor and liquid phase hydrotreatment of hydropyrolysis tar with hydrous titanium oxide catalysts.** Stephens, H.P.; Bolton, C.; Snape, C.E. (Sandia National Laboratories, Albuquerque, NM (USA)). pp 703-706 of 1987 international conference on coal science. Moulijn, J.A.; Nater, K.A.; Chermin, H.A.G. (eds.). Amsterdam, Netherlands; Elsevier Science Publishers (1987). (CONF-871030—).

From International conference on coal science; Maastricht, Netherlands (26 Oct 1987).

Describes the use of hydrous titanium oxides (HTO) catalysts containing Ni, Co, Mo and Pd to hydrotreat tar from hydropyrolysis of coal. It was found that these catalysts are capable of upgrading tar vapours to give low boiling products. Pd HTO gives a nearly fully hydrogenated product and the Co-Ni-Mo HTO catalyst provides a lower boiling product than a commercial Ni-Mo/alumina catalyst. Both of these HTO catalysts have significant activities at 300 C. 5 refs.

20904 **Recession of a coal face exposed to a high temperature.** Britten, J.A. (Lawrence Livermore National Laboratory, Livermore, CA (USA)). *International Journal of Heat and Mass Transfer;* **29**: No. 7, 965-978(Jul 1986).

A one-dimensional, transient model is developed to describe drying, pyrolysis, endothermic gasification and spalling (thermomechanical failure) of a wet coal face exposed to a high temperature. Such a situation occurs, for example, at the roof of an underground coal gasification (UCG) cavity. Emphasis is placed on thermochemistry, and rock mechanics are simplified by use of two parameters, a failure length and temperature, which measure the strength of the coal. Drying of the coal and convection of the evaporated water are modeled as a Stefan problem, and reaction of this water vapor with carbon at the free surface is described by an asymptotic solution in the limit of a large activation energy for this reaction. Thus, evaporation and gasification effects become analytic boundary conditions on the numerical solution to the transient heat penetration in the dry coal. Pyrolysis is treated numerically as the release of a single component in the dry coal according to one-step Arrhenius kinetics. Both surface gasification and spalling are shown to be of importance for typical UCG conditions, and their relative interaction can provide an explanation for UCG field test observations. The model, in particular the perturbation solution developed for the surface recession rate due to gasification, has applications in pyrolyzing ablative and related systems. 31 refs., 9 figs., 1 tab.

0105 By-products

REFER ALSO TO CITATION(S) 20803, 20912, 21007

0106 Properties

REFER ALSO TO CITATION(S) 20750, 20790, 20791, 20792, 20821, 20822, 20855, 20871, 20873, 20901, 20902, 20946, 23358

20905 **(ACI—85-197) The role of minerals and particle size in combustion of Canadian bituminous coals: mineral matter spatial distribution in coal as related to slag potential and micronizing techniques in coal combustion.** Birk, D.; O'Neil, D.; Pilgrim, J.L. (Canada Centre for Mineral and Energy Technology, Ottawa, Ontario). Aug 1986. 338p. Canada Centre for Mineral and Energy Technology Ottawa, Ontario.

This study was undertaken to determine the mineral matter associated with carbonaceous material in two ranks of coal - an eastern bituminous and a western medium volatile bituminous. As three coal particle size ranges were studied both optical and electron microscope techniques were used. The major minerals identified were: kaolinite, illite and quartz in the Western coal, and pyrite, kaolinite, illite and quartz in the Eastern coal. International literature was reviewed to provide a background for data interpretation. Petrographic, chemical and photomicrographic data on the two coals are provided in the Appendix. Recommendations for further research are included. 13 refs., 7 figs., 11 tabs.

20906 **(ARL-TR—48) Influence of the mineralogy of coal, and in particular of sulphur compounds on the possibility of sulphur removal and ash reduction.** Stirling, J.A.R. (National Research Council of Canada, Halifax, Nova Scotia). 1984. 134p. Natioanl Research Council of Canada, Halifax, Nova Scotia.

The mineralogy of sulphur compounds contained in coals has been identified as an area in which further research might prove valuable in enhancing the production and utilization of coals. The coals available in the Atlantic provinces of Canada are of particular interest in this study as beneficiation of these coals is more difficult than that of most bituminous coals in the world. This publication reports the results of a search for literature and current research concerning the inorganic mineralogy (particularly pyrite) of Maritime coals. After reviewing the available literature, recommendations were made as to areas requiring further research. As there is not much information available on the mineralogy of Maritime coals it is suggested detailed investigations in this area should become a top priority. 21 figs., 3 tabs.

20907 **(DOE/PC/60811—F1) The mobile phase in coals: Its nature and modes of release: Final report: Part 1, Structural inferences from dry catalytic hydrogenation of a subbituminous coal.** Terrer, M.T.; Derbyshire, F.J. (Pennsylvania State Univ., University Park (USA). Coal Research Section). Dec 1986. Contract FG22-83PC60811. 125p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE87003421/JAW.

In a study to provide insight into the two component structural model of coal and the mechanisms of coal liquefaction, an approach was adopted in which a subbituminous coal was reacted with hydrogen in the presence of an impregnated molybdenum sulphide catalyst and in the absence of solvent. Reactions were conducted at temperatures between 300 and 400°C and for reaction times up to 180 min. The composition and yields of gaseous prod-

ucts, chloroform-soluble liquids and insoluble residues were followed as a function of the reaction conditions by means of different analytical and characterization techniques: gas chromatography; ^1H NMR; elemental analysis; FTIR; solvent swelling in pyridine. 105 refs., 20 figs., 12 tabs.

20908 **(DOE/PC/91404—T6) Research needs and data acquisition to apply US technology to foreign coals: Quarterly report, November 1987-January 1988.** (Viking Systems International, Pittsburgh, PA (USA)). 1988. Contract AC22-86PC91404. 47p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005964/JAW.

Viking Systems International (VSI) has been providing technical assistance to the Pittsburgh Energy Technology Center (PETC) in the development of an international database on coal resources, coal characteristics and coal conversion technologies in the countries of Asia and the Pacific Basin. In Phase I of the project, databases were developed on coal characteristics, coal resources and electric utilities. During this quarter, US coals were compared with coals from countries of Asia and Pacific Basin. The purpose of this comparison is to highlight similarities or differences between US and foreign coals, which will enable one to determine the applicability of foreign coals to US developed coal technologies and identification of potential areas for technology transfer and US products and services for export. 2 refs., 19 figs., 5 tabs.

20909 **(ERP/CRL—85-74-TR) Activities of national and international standards organisations relevant to Canadian coal interest.** Janke, L. (Canada Centre for Mineral and Energy Technology, Ottawa, Ontario). Dec 1985. 61p. Canada Centre for Mineral and Energy Technology, Ottawa, Ontario.

In Canada, the American Society for Testing and Materials (ASTM) and International Standards Organization (ISO) guidelines and standards for evaluating the physical and chemical properties of coal, are employed. In this paper, a description is provided of the structure, scope and current activities of the ASTM Committee DO5 on Coal and Coke. This committee is responsible for the development of sampling, analysis and testing procedures for coal.

20910 **(NERDDP-EG—85-429) Thermal properties of boiler ash deposits.** Creek, R.C.; Becker, H.B. (National Energy Research, Development and Demonstration Council, Canberra (Australia)). 1985. vp. Department of Resources and Energy, GPO Box 858, Canberra, ACT 2601, Australia.

The objectives of this project were to (i) determine the thermal conductivity and the absorptivity of ash deposits that form on heating surfaces of boilers due to coal combustion, and (ii) to correlate the measured thermal properties of the ash deposits with their chemical and physical properties.

20911 **(NERDDP-EG—85-439) The role of oxygen-containing functional groups in hydrogenation of brown coal.** Yost, R.S. (National Energy Research, Development and Demonstration Council, Canberra (Australia)). 1985. vp. Department of Resources and Energy, GPO Box 858, Canberra, ACT 2601, Australia.

The methods available for the determination of the content of acidic oxygen-bearing functional groups in brown coal and liquid derived from brown coal conversion have been reviewed and assessed. The barium exchange method has been selected as the most useful for routine application to brown coal for the determination of total acidity, total carboxylics and carboxylates. The enthalpimetric titration technique has been established as a routine method for the determination of the total acidity of brown coal derived liquids. The methods have made a useful contribution to the study of the role of functional groups in brown coal conversion.

20912 **(NZERDC—P108) Image analysis of New Zealand coke: Carbon anode project.** Clemens, A.H. (Coal Research Association of New Zealand, Wellington). Aug 1986. 27p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88900350/JAW.

Objectives of this investigation were: (1) to characterize the porosities of Buller coal-derived coke samples being considered as possible sources of anode carbon; (2) to correlate this data with important properties of test anodes fabricated from these cokes; and (3) to identify adverse coke porosity features with respect to anode properties. The work was carried out using a semi-automated VIDS II Image Analysis system attached to a Nikon Type 704 Optiphot microscope using reflected light. The cokes all had pore size distributions different from petroleum coke. Solvent digested coke samples most closely matched petroleum coke and, in many respects, made the best test anode. The other coke types, apparently require different anode fabrication conditions in order to make a satisfactory product. 10 refs., 4 figs., 21 tabs.

20913 **(PNL—6168) Development and evaluation of supercritical fluid chromatography/mass spectrometry for polar and high-molecular-weight coal components: Technical progress report, October 1, 1986-September 30, 1987.** Chess, E.K.; Kalinoski, H.T.; Smith, R.D. (Pacific Northwest Lab., Richland, WA (USA)). Feb 1988. Contract AC06-76RL01830. 48p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006560/JAW.

This program, Development and Evaluation of Supercritical Fluid Chromatography/Mass Spectrometry for Polar and High-Molecular-Weight Coal Components, is aimed at the development of new analytical technologies for the characterization of previously intractable complex mixtures. The specific goals of this program are twofold: (1) to develop and evaluate a combined high-resolution, capillary column, supercritical fluid chromatograph/high-performance mass spectrometer (SFC/MS) that is capable of analyzing high-molecular-weight materials, such as polar and heavy-end components found in coal conversion processes; and (2) to use this system to develop and evaluate analytical technology applicable to coal process development technology. Studies have been conducted to characterize the performance of the supercritical fluid chromatograph-mass spectrometer interface, and several modifications have been made to the probe, ion source, and associated hardware to improve performance and operator safety. Methods have been developed that allow the mass calibration of the magnetic sector mass spectrometer to 1400 daltons using desorption chemical ionization. Methodologies have been improved for fabricating capillary columns with bonded, crosslinked stationary phases suitable for use with polar fluids. Coal-derived materials and fossil-fuel-derived sediments have been investigated with supercritical fluid chromatograph/mass spectrometry and supercritical fluid extraction/mass spectrometry. Microbore packed columns coupled to a modified mass spectrometer interface allowed the chemical class fractionation of relatively polar complex mixtures derived from coal liquefaction. 6 refs., 12 figs.

20914 **Narrow-boiling distillates of coal liquefaction products.** White, C.M.; Perry, M.B.; Schmidt, C.E.; Behmanesh, N.; Allen, D.T. (USDOE Pittsburgh Energy Technology Center, PA. Division of Coal Science). *Fuel;* 67: No. 1, 119-126(Jan 1988).

Coal liquefaction products from the H-coal and the Wilsonville Integrated two-stage liquefaction processes were separated into narrow-boiling distillates. The Wilsonville product was from the first stage. Information resulting from elemental analysis, proton nuclear magnetic resonance (^1H n.m.r.), low-voltage, high-resolution mass spectrometry (LVHRMS), infrared spectroscopy (i.r.) and open-column preparative liquid chromatography were obtained for each distillate. The analytical data were used to estimate the concentrations of the major functional groups in the distillates. The results indicated that the structure and functionality of the molecular constituents of the two sets of distillates boiling in the same temperature range were similar. Structural differences appear to be primarily related to the concentrations of alkylated aromatics and saturates. 27 refs., 1 fig., 8 tabs.

20915 **Correlation of liquid heat capacities for fossil fuels using characterization data.** Rodgers, P.A.; Creagh, A.L.; Prausnitz, J.M. (Lawrence Berkeley Laboratory, CA (USA). Materials and Chemical Sciences Division). *Fuel;* 67: No. 1, 134-142(Jan 1988).

Heat capacities for liquid fossil-fuel fractions are correlated as a function of characterization data. The correlation uses molecu-

lar weight from freezing-point-depression or gel-permeation-chromatography measurements, molar hydrogen-to-carbon ratio from elemental analysis, hydrogen distribution from proton-nuclear-magnetic-resonance data, and if available, number of methyl, hydroxyl, primary amine and secondary amine groups per molecule from IR spectroscopy. The correlation is established for temperatures below 500K using characterization data for 118 pure hydrocarbons; the average deviation from experiment is 2.3%. When the correlation is used to predict the heat capacities of nine petroleum fractions, the average deviation is 2.6%. Average deviations for 14 coal-derived liquids are about 6.5%, but for those liquids containing more than about 3wt% oxygen, the average deviation is somewhat lower. 97 refs., 1 fig., 10 tabs.

20916 **Structural information from the selective methylation of acidic O-H and C-H sites in coal.** Chambers, R.R.; Hagaman, E.W.; Woody, M.C. (Oak Ridge National Laboratory, Oak Ridge, TN (USA). Chemistry Division). pp 741-744 of 1987 international conference on coal science. Moulijn, J.A.; Nater, K.A.; Chermin, H.A.G. (eds.). Amsterdam, Netherlands; Elsevier Science Publishers (1987). (CONF-871030—).

From International conference on coal science; Maastricht, Netherlands (26 Oct 1987).

A detailed description of coal structure and reactivity can be achieved by the application of techniques which include selective chemical modification and nmr spectroscopy. This has been illustrated by O-methylation of a vitrinite-rich, low volatile bituminous coal, and C-methylation of the pH 12 O-methyl coal. The importance of considering chemical restraints during reaction together with nmr spectroscopic results is discussed. 12 refs.

0108 Waste Management

REFER ALSO TO CITATION(S) 20748, 20785, 20946

20917 **(EPRI-CS—5625) Sampling and analytic protocol for advanced SO_2 control by-products: Final report.** Achord, R.D.; Behl, A.E.; Owens, J.B.; Thompson, C.M.; Williams, P.N. (ICF Technology, Inc., Richland, WA (USA); Radian Corp., Austin, TX (USA)). Feb 1988. 342p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920195/JAW.

The Electric Power Research Institute (EPRI) initiated a waste management assessment project (RP 2708-1) to collect information to: (1) assess the significance of waste management problems; (2) formulate preliminary solutions; and (3) suggest future research and development activities in this area. The outcome of this project, entitled advanced SO_2 Control Waste Management, will be technical guidelines that can be used in the design and operation of waste management systems for advanced SO_2 control processes. This document describes the information and methods that are needed to collect and analyze samples for this project. It includes general sampling approaches that are common to all wastes types for the project and generic sampling plans. It also includes a characterization test matrix and flow chart, justification of analyses and tests, descriptions of analyses and tests, data management procedures, and data quality evaluation criteria and requirements. 36 refs., 10 figs., 11 tabs.

0109 Environmental Aspects

REFER ALSO TO CITATION(S) 20825, 20877, 20888, 20889, 20890, 20891, 20892, 20893, 20894, 20895, 20896, 20897, 20898, 20917, 20928, 20929, 22749, 23132

20918 **(NERDDP-EG—85-426) Atmospheric response to fossil fuel combustion.** Francey, R.J.; Pearman, G.I. (National Energy Research, Development and Demonstration Council, Canberra (Australia)). 1983. vp. Department of Resources and Energy, GPO Box 858, Canberra, ACT 2601, Australia.

The objective of this project was to identify the major environmental factors which influence isotopic fractionation of carbon as it is removed from the atmosphere and stored in annual tree rings; to use this knowledge to determine the possibility of selecting suitable isotopic records for reducing the atmospheric trends of stable carbon isotopes over the past 100 years; and to determine, if possible, the total release of fossil and biospheric carbon into the atmosphere over this time period.

0110 Reserves And Exploration

REFER ALSO TO CITATION(S) 20872

20919 **(ARC-OF—1986-14) Geological studies of coal in Alberta: a status report.** Langenberg, C.W.; MacDonald, D.E.; Richardson, R.J.H. (Alberta Research Council, Edmonton (Canada)). Dec 1986. 116p. Alberta Research Council, Edmonton, Canada.

An exaination of information currently available on the geology of coal in Alberta was undertaken. Seven fields of research were identified: coal quality, stratigraphy, structural geology, sedimentology, coal data bases, geophysics and resource calculations. Using this information and the knowledge and opinions of 12 Albertan coal mining companies and consultants, an attempt was made to identify the direction which research in coal geology in Alberta should take. When the research fields were ranked and results compared, it was determined coal quality is the most important field of research, structural geology and coal databases were second, stratigraphy and sedimentology were third, and geophysics and resource calculations ranked fourth. From the information compiled a set of recommendations for research work in coal geography by the Alberta Research Council was developed. 70 refs., 19 figs.

20920 **(COAL/GE—4/R-36) Technical activities of research and design institutes in the coal-mining industry.** (United Nations, Geneva (Switzerland). Economic Commission for Europe). 3 Nov 1987. 5p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88900389/JAW.

Bulgaria's coal reserves are very limited. Moreover, they are concentrated in deposits where natural and technical coal-getting conditions are complex: irregular bedding, unfavorable physical and mechanical winning conditions, poor physical and mechanical properties of the coal and enclosing rock, considerable gassiness and water intrusion, liability to spontaneous combustion, heavy faulting, coal with a high ash content and of low calorific value, high content of harmful inclusions, etc. Complex bedding and winning conditions make it difficult to work coal seams efficiently. Highly-efficient mechanized coal-setting devices for use in difficult mining conditions are not being developed anywhere in the world, and the use of existing equipment does not give the best results. For this reason, more efficient winning operations depend on the solution of a large variety of complex problems which are being referred to the research and development departments of MNIPKI "Minproekt." The main areas in which research is being carried out are described briefly.

20921 **(ERP/CRL—86-40-TR) Coal reserves in Canada: 1985.** Naidu, H.G. (Canada Centre for Mineral and Energy Technology, Devon, Alberta. Coal Research Centre Devon). Mar 1986. 42p. Department of Energy, Mines and Resources, Calgary, Alberta.

This is the fifth in a series of reports documenting Canada's coal resources and reserves in terms of quantity and quality. Recoverable coal quantities are provided for each of the coal producing provinces. As well, information is provided as to the rank of coals being mined. This data updates information found in previous reports to December 31, 1985. 10 refs., 2 figs., 4 tabs.

20922 **(NEDO—8502) Survey report on expansion of coal flow in Pacific countries.** (New Energy Development Organization, Tokyo (Japan)). Apr 1986. 254p. (In Japanese). New Energy Development Organization, 1-1, 3-Chome, Higashiikebukuro, Toshima-ku, Tokyo, Japan.

Coal is the major substitute energy source to replace oil. A pacific Coal Flow Concept has been developed in pursuit of smooth expansion of coal trade by coordinating potential coal de-

mands with strong supply capacity in various Pacific states through proper international cooperation. The concept also calls for each nation's efforts to exploit domestic coal and to promote supply and utilization of it. This survey, which is intended for providing information that will help promote the plan, covers Korea, Taiwan, Hong Kong, China and the five ASEAN members composed of the Philippines, Thailand, Malaysia, Singapore and Indonesia. Excluding Hong Kong and Singapore, the remaining seven countries have coal resources. A study is made on problems involved in the coal exploration, exploitation, production and related infrastructures. Another study is focused on the needs for Japan's cooperation and application of coal produced. The coal utilization promotion plans of each country, problems involved in them and measures taken by the Japanese government are also examined. (36 figs, 126 tabs, 100 refs)

20923 (NEDOJ—8401, pp 199-210) **Basic investigation for development of coal resources in Japan.** Aug 1984. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770050/JAW.

In FY 1983 NEDO Annual Report.

This report describes the result of the study on coal resources in Japan through geophysical prospecting and boring. The study was conducted in 1982 and 1983. of special interest is that the geophysical prospecting process was introduced to the ocean area exploration. (1) Off shore of Nishisonogi area (Fukuoka Prefecture); Two marine borings and geophysical prospecting were carried out to confirm the existence of main coal bearing formation. (2) Ariake sea area (Fukuoka Prefecture); By executing two marine borings and geophysical prospecting, an excellent coal seam was proved extending continuously in the west of the Miike colliery. (3) Shinjo area (Hokkaido Prefecture); Four on-shore borings were executed. However, it was evaluated that the coal field was of poor value. (4) Kitaashibetsu area (Hokkaido Prefecture); Four on-shore borings were performed to confirm several promising coal seams. (5) Hokuyo area (Hokkaido Prefecture); Four on-shore borings were conducted to reach several coal seams.

20924 (NEDOJ—8701, pp 157-164) **Fundamental survey for coal source development.** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A14. Order Number DE88770075/JAW.

In FY 1986 NEDO Annual Report (Part 1).

For correct information of coal resources in Japan and enhancement of coal resource exploration techniques, unexamined but promising coal resource districts in Japan were systematically examined by coal exploration utilizing new analytical technique and drilling. This exploration project started in 1982. Six offshore geophysical surveys, and forty four appraisal drilling were practiced for determining coal deposits in each district. In 1986, the successive survey and appraisal drilling were made in six districts. The reanalyses for the offshore geologic survey in Ariake sea district utilized new techniques such as partial migration of polymer, model analysis, etc., revealing the effectiveness for coal deposit structure. For Asagaya and Saruwatari district, VSP exploration utilizing appraisal drilling was conducted, giving reflection recordings corresponding to the geologic informations, which were useful for the precise data evaluation. (3 figs, 1 tab)

20925 (NEDOJ—8701, pp 165-167) **Oversea Geologic structure survey of overseas coal resources.** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A14. Order Number DE88770075/JAW.

In FY 1986 NEDO Annual Report (Part 1).

For stabilized supply of overseas coal, cooperation of geologic surveys are made in communist nations, in which the coal development is difficult for private enterprises, and developing countries. This survey started as Japan-China cooperation survey in 1982. In the Ryushou coal mine district, the Junnan coal field was surveyed. Japan made the geophysical survey utilizing the seismic prospecting method, etc. China conducted the appraisal drilling. Eventually, the data were totally analyzed, and the survey was completed in 1986. The geologic data necessary for coal mine development, such as the geologic structure, coal grade, etc. were provided. In 1986, Japan-China cooperation exploration started in the Scinei coal district of Santoushou, in China, and Japan-Indonesia coal exploration in the middle Sumatra coal field. The two explorations are a five year project till 1991. In 1986, total planning, seismic-prospecting exploration and boring in the Toukou district, field surveying in the middle Sumatra coal field, selection of prospect coal district were made. (3 figs)

20926 (NERDDP-EG—85-423) **Development of computerised basin study techniques and application to resource studies.** Wiltshire, M.J. (National Energy Research, Development and Demonstration Council, Canberra (Australia)). 1985. vp. Department of Resources and Energy, GPO Box 858, Canberra, ACT 2601, Australia.

A new, geologically oriented system for geophysical log editing and redisplay was developed by Technical Computer Systems and Wiltshire Geological Services between early 1980 and late 1982. This system has proven quite valuable as a geologic tool in basin studies, since it is designed to enhance wireline log display from the viewpoint of this stratigraphic mapper. Radically new interpretations of depositional units and basin evolution have resulted in the one area previously studied. Work conducted under the present project has considerably enhanced the previously existing software.

20927 (PB—88-133517/XAB) **Character of five selected LANDSAT lineaments in southwestern Pennsylvania. Report of investigations/1987.** Moebs, N.N.; Sames, G.P. (Bureau of Mines, Pittsburgh, PA (USA). Pittsburgh Research Center). 1987. 31p. (BM-RI—9104). NTIS, PC A03/MF A01.

Library of Congress catalog card No. 86-607593.

Five LANDSAT lineaments in the coal-mining region of southwestern Pennsylvania were investigated by the Bureau of Mines to determine their geologic character, relation to subsurface conditions, and the means of discriminating one from another. The investigation included earth resistivity and very-low-frequency electromagnetic traverses, soil-moisture sampling, and a correlation with coal-mine roof conditions. The lineaments could not be detected by the methods used, suggesting that they might be a surface phenomenon unrelated to subsurface geologic structures or roof stability in coal-mine workings beneath.

0120 Mining

REFER ALSO TO CITATION(S) 20920, 20922, 21003, 21004

20928 (COAL/GE—5/R-36/Add.9) **Problems encountered in the establishment of plant growth on infertile overburden mounds.** (United Nations, Geneva (Switzerland). Economic Commission for Europe). 10 Nov 1987. 5p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88900387/JAW.

The results of research and practical recultivation show that it is entirely possible to effect rapid and successful recultivation and protect the environment on the surface of mounds constructed without a process of selection either at the winning or at the dumping stage. The combined technology which has been developed for technical and biological rehabilitation may be used with success not only for mounds near opencast mines, but also for other disrupted areas, for the purpose of restoring their fertility or protecting the environment. The principal advantage of this method of recultivation is the substantial reduction in the amount of work involved in selective mining and transport of the topsoil in the traditional method of recultivation with humification, with a consequent sharp reduction in expenditure on materials.

20929 (COAL/GE—5/R-36/Add.10) **Problems encountered in the establishment of plant growth on infertile overburden.** (United Nations, Geneva (Switzerland). Economic Commission for Europe). 10 Nov 1987. 7p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88900388/JAW.

The German Democratic Republic has strong statutory rules concerning the protection of the environment during the preparation and working of opencast mine sites. These rules also govern the use for mining purposes and the subsequent restoration, including the recultivation, of agricultural, forest and water-management

land. In view of the limited availability of land in the German Democratic Republic, the rehabilitation of mining areas is of great social importance. Consequently, the problems of rehabilitation are taken into account right from the stage of the planning of deposit development and preparation of the methods of work. The measures to be taken for rehabilitation are set out in the five-year and annual plans and are voted and approved in the form of a planning document by the local authorities. Implementation of the planned set of rehabilitation activities is subject to constant social control. Rehabilitation measures form an integral part of every opencast mining project, being set out and explained in the section of the project document entitled "Landscaping of the areas damaged by mining activities." The question who does the work on vegetation has already been answered above: technical rehabilitation is carried out by the mining enterprises, and biological rehabilitation by agricultural or forestry enterprises. It is the end-user who undertakes the planned maintenance of rehabilitated land. The work is certain to be carried out, since all rehabilitated land is included in the state agricultural and forest land stock, and thus comes under the scrutiny of the national authorities during the compilation of the land balance.

20930 **(DOE/EIA—0218(88/01)) Weekly coal production for week ended: January 2, 1988.** (USDOE Energy Information Administration, Washington, DC). 15 Jan 1988. 4p. NTIS, PC A02/MF A01 - GPO; GPO Dep. Order Number DE88005769/JAW.

US coal production in the week ended January 2, 1988, as estimated by the Energy Information Administration, totaled 12.8 million short tons (bituminous coal and lignite, nearly 12.8 million short tons; Pennsylvania anthracite, .03 million short tons). This was 1.8% lower than production in the previous week. The preliminary estimate of 1987 production is a record 916,851 thousand short tons, surpassing the previous record 1984 production 895,921 thousand short tons by 2.3%. Compared with 1986 production of 890,315 thousand short tons, the preliminary 1987 estimate represents an increase of 3.0%. Detailed estimates by state will appear in the next issue of Weekly Coal Production. The 1987 production estimate includes a revision to third quarter estimates for 1987.

20931 **(ERP/CRL—86-144-TR) An analysis of Easi-Miner time study data at Obed Mountain Mine.** Szymanski, J.K.; Heximer, M.; Veldhuis, D.; LaRocque, G.H. (Canada Centre for Mineral and Energy Technology, Devon, Alberta. Coal Research Centre Devon). Dec 1986. 58p. Canada Centre for Mineral and Energy Technology, Devon, Alberta. Coal Research Centre Devon.

A time study analysis was undertaken of the 'Easi-Miner' operation at Obed Mountain mine, as an initial step towards the development of a computerized simulation model. Easi-Miner and truck network cycle times were monitored. Weibull distribution parameters were then estimated for all components of the cycle. These estimates will create a base for the future development of a simulation model of the Easi-Miner, continuous surface mining method. 3 refs., 37 figs., 1 tab.

20932 **(ERP/CRL—86-145-TR) Rheinland's mine Hambach in West Germany.** Srajer, V. (Canada Centre for Mineral and Energy Technology, Devon, Alberta. Coal Research Centre Devon). Dec 1986. 16p. Canada Centre for Mineral and Energy Technology Devon, Alberta. Coal Research Centre Devon.

The Hambach mine in the Rheinland coal mining district of West Germany is described. This open cast mine is the newest and largest German mine today. The resources of lignite (brown coal) produced in 1986 were expected to reach 20 Mt. At full capacity the mine is expected to produce 50 Mt of lignite annually. 3 refs., 9 figs.

20933 **(ERP/CRL—86-146(TR)) Surface coal mining in Yugoslavia.** Srajer, V. (Canada Centre for Mineral and Energy Technology, Devon, Alberta. Coal Research Centre Devon). Dec 1986. 17p. Canada Centre for Mineral and Energy Technology Devon, Alberta. Coal Research Centre, Devon.

Brief report of a visit to the surface coal mines in the Tuzla basin in Yugoslavia. The visited mines are very new and still partly under construction. The coal found in the area is 90% lignite, 9.5% brown coal, and 0.5% hard coal. The continuous mining system is the dominant mining method used at these Yugoslavian mines. 3 refs., 6 figs., 3 tabs.

20934 **(ERP/CRL—87-8-TR) Remote measurement of methane in coal mines: a review.** Konda, B.W.; Mitchner, R.C.; Hollinger, A.B. (Canada Centre for Mineral and Energy Technology, Sydney, Nova Scotia. Cape Breton Coal Research Lab.). Feb 1987. 19p. Canada Centre for Mineral and Technology, Sydney, Nova Scotia (Canada). Cape Breton Coal Research Laboratory.

The authors identify a need for a device which can remotely measure methane in coal mines. Similar techniques which have been used to measure atmospheric pollutants are discussed. These techniques include adsorption, Raman scattering and fluorescence. While differential adsorption and Raman scattering techniques have potential there are a number of problems to be resolved before they could be applied effectively. It is felt that an area which may provide suitable technology sometime in the future is in the field of laser sources. 6 refs., 4 tabs.

20935 **(ERP/CRL—87-07) Computer aided rapid determination of the explosibility of mine fire gases.** Klinowski, W.G. (Canada Centre for Mineral and Energy Technology, Sydney, Nova Scotia. Cape Breton Coal Research Lab.). Feb 1987. 8p. CANMET, Sydney, Nova Scotia (Canada). Cape Breton Coal Research Laboratory.

This paper provides a description of a computer program designed to monitor information on explosibility limits and any trends and changes in the fire gas composition through monitoring of an underground mine atmosphere. The computer program can calculate and plot an explosibility diagram for the entered results of the fire atmosphere analysis. 1 ref., 2 figs.

20936 **(ERP/CRL—87-13-TR) An overview of microprocessor systems for monitoring equipment performance.** Naidu, H.G. (Canada Centre for Mineral and Energy Technology, Devon, Alberta. Coal Research Centre Devon). Feb 1987. 37p. Canada Centre for Mineral and Energy Technology, Devon, Alberta. Coal Research Centre Devon.

Trends in the coal mining industry indicate the use of microprocessor controlled equipment monitoring systems are an effective way of reducing costs and increasing productivity. This paper introduces a number of devices currently used in the industry. Systems are available for monitoring draglines, shovels, blasthole drills, frontend loaders, backhoes and off-highway vehicles. 11 refs., 17 figs., 4 tabs.

20937 **(PB—88-129465/XAB) MULSIM/BM: a structural analysis computer program for mine design. Software.** Beckett, L.A. (Bureau of Mines, Denver, CO (USA). Denver Research Center). Dec 1987. mag tap. NTIS CP T05.

Source tape is in the ASCII character set. This restricts preparation to 9 track, one-half inch tape only. Identify recording mode by specifying density only. Call NTIS Computer Products if you have questions. Price includes documentation, PB—88-129473.

The Bureau of Mines has developed MULSIM/BM, an improved computer program using the boundary-element approach for geomechanical analysis of mine plans in single or multiple coal seams. The report presents the improved features of the MULSIM/BM program. The four major improvements are the following: (1) Ability to specify up to 26 material property sets; (2) a new material model capability for gob and inserted materials, such as packwalls or cribs; (3) ability to model a large area with a grid of undivided blocks and to subdivide only a specified fine-mesh portion of these blocks into elements; and (4) specification of extraction ratios for the undivided blocks. In addition, an interactive-graphics mesh-generator program was written to accompany MULSIM/BM. A complete user's guide and program listings are provided in appendises to the report. The nine-track computer tape is written at the density of 1600 bits per inch, using unlabeled tape format. The programs are written in ASCII code as 4960 fixed-length records, or card images, with 80 characters per record...Software Description:

The model is written in the FORTRAN programming language for implementation on a CDC Cyber 170 Computer using the NOS2 operating system.

20938 (PB—88-129473/XAB) MULSIM/BM: a structural analysis computer program for mine design. user's guide. Beckett, L.A.; Madrid, R.S. (Bureau of Mines, Denver, CO (USA). Denver Research Center). Dec 1987. 255p. (BM-IC—9168). NTIS, PC A12/MF A01.

For system on magnetic tape, see PB—88-129465.

The Bureau of Mines has developed MULSIM/BM, an improved computer program using the boundary element approach for geomechanical analysis of mine plans in single or multiple coal seams. The report presents the improved features of the MULSIM/BM program. The four major improvements are the following: (1) Ability to specify up to 26 material property sets; (2) a new material model capability for gob and inserted materials, such as packwalls or cribs; (3) ability to model a large area with a grid of undivided blocks and to sub-divide only a specified fine-mesh portion of these blocks into elements; and (4) specification of extraction ratios for the undivided blocks. In addition, an interactive-graphics mesh-generator program was written to accompany MULSIM/BM. A complete user's guide and program listings are provided in appendixes to the report. The nine-track computer tape is written at the density of 1600 bits per inch, using unlabeled tape format. The programs are written in ASCII code as 4960 fixed length records or card images, with 80 characters per record.

20939 (PB—88-133061/XAB) Surface testing and evaluation of the monorail bridge conveyor system. Information Circular/1987. Evans, R.J.; Mayercheck, W.D.; Saliunas, J.L. (Bureau of Mines, Pittsburgh, PA (USA). Pittsburgh Research Center). 1987. 42p. (BM-IC—9146). NTIS, PC A03/MF A01.

Library of Congress catalog card No. 86-600401.

The monorail bridge conveyor (MBC) is a prototype continuous-face haulage system that was surface tested and evaluated by the Bureau of Mines. The MBC consists of a series of cascading belt bridge conveyors suspended from roof-supported monorail track. Tests were conducted to determine MBC haulage capability, maneuverability, power consumption, and reliability using rigid and chain-suspended monorail track installations. Subsequent modifications to improve operation and reliability made during surface testing are described.

20940 (PB—88-133673/XAB) Control of diesel-exhaust emissions in underground mines. Open File report, May 1979-July 1985. Stawsky, A.; Lawson, A.; Vergeer, H.; Manicom, B.; Drummond, W. (Engelhard Corp., Edison, NJ (USA). Specialty Chemicals Div.). May 1987. 402p. NTIS, PC A18/MF A01.

This report describes an experimental survey of diesel emission after-treatment control techniques, including water scrubbers, catalytic converters, exhaust gas recirculation, and soot filters. The use of two or more techniques in combination was tested for optimum control of all exhaust pollutants, and dynamometer data was developed for steady-state and computer-controlled simulated mines duty cycles operation of Deutz F6L-714 and F8L-413 engines. Exhaust-quality indices were calculated from dynamometer data for comparisons among the control combinations examined.

0130 Transport And Handling

REFER ALSO TO CITATION(S) 20870, 20872, 20899, 20922

20941 (ARL-TR—49) The effects of freezing and thawing upon fuels made from coal and water. Sedman, K.G.; Thornley, J.C. (National Research Council of Canada, Halifax, Nova Scotia). 1984. 47p. National Research Council of Canada, Halifax, Nova Scotia.

In this report the effects of temperature changes on Carbogel, a nominal 70% coal/30% water mixture developed in Sweden, and now manufactured by the Cape Breton Development Corporation, are examined. Of particular concern were the effects of transportation and storage of the fuel in the Canadian wintertime, when it might be exposed to freezing temperatures. Experiments provided information on some properties of Carbogel in temperature ranges from 0.C to 20 C. No significant effects were observed in the stability and particle distribution of repeatedly frozen and thawed Carbogel. While freezing of Carbogel filled pipes did result in plastic deformation or rupture after one freeze/thaw cycle, it was expected it may occur after a number of cycles. 6 refs.

20942 (DOE/MC/21349—2531) Reduction of erosion in elbows due to flow modifications: Final report, Phase 1. Johnson, E.K.; Means, K.H.; Eyler, R.L.; Holtzworth, J.D. (West Virginia Univ., Morgantown (USA). Dept. of Mechanical and Aerospace Engineering). Nov 1987. Contract AC21-84MC21349. 96p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88001028/JAW.

The objective of this project is to investigate the concept of flow-field modification as a method for reducing erosion in bends (elbows) used in pneumatic transport systems. Flow field modifications were primarily accomplished by injecting air at selected locations within the bends. Part I of this project shows the feasibility of the concept. Part II of this project will include further experiments and analysis, leading to a design methodology for incorporating this concept into piping systems. This report represents the final report for Part I of this project. This report contains a survey of the literature dealing with the erosion in bends (elbows) and the fundamental subjects of erosion and two-phase, gas-solids, flow. Based on this literature survey, a pneumatic transport test loop was constructed. Several bend designs were tested, using sand, under a variety of operating conditions. The results of this exploratory effort indicate that modifying the flow field in a bend with jets may: (1) decrease erosion; (2) change the erosion pattern with the same amount of erosion; or (3) significantly increase the erosion process. Data indicate that the erosion rate may be reduced by low-velocity jets for high phase-density flow. Apparently the interaction of jets with dilute phase-density flow tends to accelerate the erosion process. It is recommended that the project be continued in order to more fully understand the process and its capabilities to solve the difficult technical problem of erosion in bends (elbows).

20943 (DOE/PC/90518—T3) Aerated and vibrated chute feeders for particulate materials: Quarterly technical report for the period September 1, 1987 to November 31, 1987. Jackson, R. (Princeton Univ., NJ (USA). Dept. of Chemical Engineering). 1987. Contract FG22-86PC90518. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004201/JAW.

As part of our project to investigate methods for the transportation of granular materials, we have been studying the gravity-driven flow of particulates down inclined chutes influenced by aeration and vibration. We have thus far proposed fundamentally-based equations of motion which model the rheological behaviour of these materials, and boundary conditions for solid boundaries and free-surfaces. We have also been involved in devising experiments to study the efficacy of our theoretical model, and to evaluate the effects of aeration and vibration in this process. In this report, we recall the proposed equations of motion and boundary conditions that describe the inclined chute flow. We also present the newly obtained results of our simulations of aerated chute flow. 9 refs., 3 figs., 2 tabs.

20944 (DOE/PC/90962—T5) Experiments on densely-loaded non-Newtonian slurries in laminar and turbulent pipe flows: Quarterly technical progress report No. 5. Park, J.T.; Mannheimer, R.J.; Grimley, T.A.; Morrow, T.B. (Southwest Research Inst., San Antonio, TX (USA)). 23 Feb 1988. Contract FG22-86PC90962. 47p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006209/JAW.

An experimental description of the flow structure of non-Newtonian slurries in the laminar, transitional, and full turbulent pipe flow regimes is the primary objective of this research. Measurements include rheological characterization of the fluid and local fluid velocity measurements with a laser Doppler velocimeter (LDV). Optical access to the flow is gained through a test section and model slurry which are both transparent. The model slurry is formulated from silica gel particles and hydrocarbon liquid mixture

whose indices of refraction are matched so that light is not scattered from the particles. Experiments are being conducted in a large-scale pipe slurry flow facility with an inside pipe diameter of 51 mm (2 inches). Detailed flow measurements including turbulence quantities such as Reynolds stress were measured with a two-component two-color LDV. The present research indicates that non-Newtonian slurries are possible with concentrations of a few percent by weight of small particles whose sizes are one micron or less. A non-Newtonian slurry from small particles could maintain large particles (100 micron size) at high concentrations in suspension almost indefinitely. Such a slurry would prevent particle fallout and its associated problems. Velocity profiles were acquired by the LDV in the laminar, transitional, and turbulent flow regimes. The velocity profile for laminar flow was in agreement with theory. The range of the transition region was 21% of the transition velocity in comparison to 50% for a Newtonian fluid. 22 refs., 26 figs., 2 tabs.

0140 Combustion

REFER ALSO TO CITATION(S) 20748, 20750, 20753, 20784, 20900, 20905, 20910, 21979, 22229

20945 **(CONF-871191—2) Metal wastage analysis of carbon steel tubes from TVA 20 MW AFBC [atmospheric fluidized-bed combustion].** Natesan, K. (Argonne National Lab., IL (USA)). Nov 1987. Contract W-31109-ENG-38. 23p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005948/JAW.

From Workshop on wastage of in-bed surfaces in fluidized-bed combustors; Argonne, IL, USA (2 Nov 1987).

Evaporator tubes of carbon steel material, obtained from the TVA 20 MW AFBC test facility, were examined for deposit formation and metal wastage. Three different regions of the tube sections were analyzed using electron diffraction and several electron-optical techniques. The results showed that excessive metal wastage in one of the locations can be attributed to erosive wear of chlorine impregnated iron oxide scales. The results also showed that corrosion accelerating elements such as Cl, S, and K act independent of each other on the carbon steel evaporator tubes and it is imperative to characterize the local environment in the vicinity of the tube banks for understanding the complex deposition/corrosion phenomena that occur in FBC systems. 2 refs., 11 figs., 1 tab.

20946 **(DOE/PC/70770—T10) Fundamental studies of the mechanisms of slag deposit formation: Final report.** Austin, L.G.; Benson, S.; Rabinovich, A.; Tangsathitkulchai, M.; Schobert H.H. (Pennsylvania State Univ., University Park (USA). Coll. of Earth and Mineral Sciences). Jul 1987. Contract FG22-84PC70770. 191p. NTIS, PC A09/MF A01; 1; GPO Dep. Order Number DE87013912/JAW.

The kinetics of ash deposition on utility boilers have been studied. A heated tube furnace system was used in the study. Areas of consideration in the deposition mechanics were: close space knowledge of chemical composition and distribution of inorganic constituents in coal, transformations and reactions of the inorganic constituents in the flame, ash transport mechanisms, initial adhesion of ash particles to heat transfer surfaces and subsequently to each other to form a deposit, and further interactions of the deposited ash to grow a strong deposit. Interactions of deposited ash that cause changes in physical and chemical properties in an aged deposit are due to processes such as sintering, chemical reactions, and melting. The degree of these changes increases as the deposit grows from the heat transfer surfaces where it forms. All of these changes during the deposit formation process are coal-specific and are strongly dependent on the boiler configuration and operating conditions. 18 refs., 55 figs., 42 tabs.

20947 **(DOE/PC/90957—T5) Fluidization mechanisms in slurry flows: Quarterly report.** Campbell, C.S. (University of Southern California, Los Angeles (USA). Dept. of Mechanical Engineering). Jan 1988. Contract FG22-86PC90957. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005191/JAW.

There are two major events to report this time around. The first is the successful second startup of the slurry pipe loop which showed that the loop could accept particles in the dense phase region (around 50% by volume), but unfortunately, resulted in a failure in one of the rectangular channel sections after the pump had difficulty passing the particles at that density. The second involves a change in fluidization mechanism determination required by problems with drift in the commercial fiber-optic displacement transducers used in the particle pressure probes. Both mean that the project is falling behind schedule.

20948 (EUR—10567, pp 1127-1140) **Erosion and corrosion resistance of materials for fluidized bed combustors.** Tiainen, T.; Siitonen, P.; Kettunen, P. (Tampere University of Technology (Finland). Institute of Materials Science). 1986. D. Reidel Publishing Co., Dordrecht, Netherlands. (CONF-861025—).

From 3. conference on high temperature alloys for gas turbines and other applications; Liege, Belgium (6 Oct 1986).

Erosion and corrosion resistance of different candidate materials and coatings under circumstances present in Atmospheric Fluidized Bed Combustion (AFBC) was studied by both laboratory scale simulative experiments and exposures in a real industrial AFBC boiler of a static bed type. In pure oxidation tests performed at the temperature of 900 degrees C in the laboratory scale test rig and at different contents of sulphur dioxide in the atmosphere the ferritic chromium steels with chromium content lower than 14% formed on their surfaces a thick, non-protective oxide layer and their oxidation rate was quite high. The studied ferritic steels with higher chromium contents, the studied austenitic steels and superalloys formed on their surface a protective oxide layer which produced also low oxidation rates. In laboratory scale simulative erosion-corrosion tests at the temperature of 900 degrees C all studied materials showed about similar erosion rates with no sulphur dioxide addition. With increasing sulphur dioxide content of the atmosphere the austenitic steels and superalloys showed best erosion-corrosion resistances while, however, the erosion-corrosion rates of all materials were significantly increased due to sulphur dioxide addition. In the full scale tests at the metal temperature of 400 degrees C within a static bed type 14 MW AFBC boiler the austenitic steels and the ferritic high-chromium steel gave the best erosion-corrosion resistance in both splash zone and in freeboard whereas the high nickel alloys had the highest erosion-corrosion and oxidation rates in these experiments. The plasma sprayed ceramic coatings did not give any satisfactory protection against oxidation or erosion-corrosion in either the laboratory tests or in the full scale tests within the 14 MW static bed AFBC boiler. This was due to both the porosity of the coatings and the spalling of the coatings at test temperature. 4 refs., 6 figs., 4 tabs.

20949 (EUR—10567, pp 1141-1154) **Characterization of deposits formed in fluidized bed combustors.** Saunders, S.R.J.; Spencer, S.J. (National Physical Laboratory, Middlesex (United Kingdom)). 1986. D. Reidel Publishing Company, Dordrecht, Netherlands. (CONF-861025—).

From 3. conference on high temperature alloys for gas turbines and other applications; Liege, Belgium (6 Oct 1986).

The structure and composition of deposits on heat exchanger tubing formed under a variety of different operating conditions in fluidized bed combustors have been studied and related to the observed high temperature corrosion of these materials exposed to the same environment. The results obtained indicate that sulphidation of these alloys can be influenced by porosity of the deposit, decomposition of $CaSO_4$ within the deposit and a solid-state reaction between the deposit and protective oxide scale. The relative influence of these parameters can change and depends on the details of the deposit properties. 10 refs., 5 figs., 6 tabs.

20950 (EUR—10567, pp 269-291) **Materials requirements and selection for fluidized bed combustors.** Rademakers, P.L.F.; Kettunen, P.O. (Metal Research Institute TNO, Apeldoorn (Netherlands)). 1986. D. Reidel Publishing Company, Dordrecht, Netherlands. (CONF-861025—).

From 3. conference on high temperature alloys for gas turbines and other applications; Liege, Belgium (6 Oct 1986).

Fluidized Bed Combustion is a fast developing energy production technique, which offers several potential advantages compared with conventional techniques. Materials behaviour is a key

aspect for this development in different areas of FBC systems, e.g. in-bed tube bundles. In this review the corrosion and erosion phenomena, which can occur are described. The present situation and the existing knowledge with respect to the materials requirements and selection are discussed. 35 refs., 7 figs., 2 tabs.

20951 **Optical diagnostics for in-situ measurements in pulverized coal combustion environments.** Hardesty, D.R.; Ottesen, D.K. (Sandia National Laboratories, Livermore, CA (USA)). pp 321-346 of Fundamentals of the physical-chemistry of pulverized coal conbustion. Lahaye, J.; Prado, G. (eds.). Dordrecht, Netherlands; Martinus Nijhoff Publishers (1987). (CONF-8607361—).

From NATO advanced research workshop on fundamentals of the physical-chemistry of pulverized coal combustion; Les Arcs, France (28 Jul 1986).

Recent progress in understanding pulverized coal combustion is attributable, in part, to the use of new optical diagnostics for in situ measurements of gas temperature, concentrations of major and trace gas species, particle size distribution, and gas and particle velocity fields. This paper emphasizes the features of optical diagnostics that have the greatest potential for near-term application to detect the properties of gaseous or particulate species in small-scale pulverized coal combustion experiments. 27 refs., 16 figs.

20952 **In situ real-time analysis of particulates using laser spark spectroscopy.** Ottesen, D.K. (Sandia National Laboratories, Livermore, CA (USA). Combustion Research Facility). pp 777-780 of 1987 international conference on coal science. Moulijn, J.A.; Nater, K.A.; Chermin, H.A.G. (eds.). Amsterdam, Netherlands; Elsevier Science Publishers (1987). (CONF-871030—).

From International conference on coal science; Maastricht, Netherlands (26 Oct 1987).

Describes the use of laser spark spectroscopy as a non-intrusive optical technique for determining the composition of entrained coal, char and mineral matter particles in the combustion zone. In particular, the simultaneous real-time in situ measurement of the size, velocity and composition of individual particulates is required. The technique appears promising, but more work remains to be done on calibration and in the application of the technique to high temperature environments. 6 refs.

20953 **Percolation model for simulation of char oxidation and fragmentation time-histories.** Kerstein, A.R.; Edwards, B.F. (Sandia National Laboratories, Livermore, CA (USA). Combustion Research Facility). pp 785-788 of 1987 international conference on coal science. Moulijn, J.A.; Nater, K.A.; Chermin, H.A.G. (eds.). Amsterdam, Netherlands; Elsevier Science Publishers (1987). (CONF-871030—).

From International conference on coal science; Maastricht, Netherlands (26 Oct 1987).

A computational model has been developed to represent the evolution of char morphology during oxidation. The model is designed primarily to identify the effect of fragmentation on particle burning-rate time histories. The computations involve the simulated burning of char particles based on a model of particle macrostructure consisting of a cluster of randomly selected bonds of a cubic lattice. Percolation theory is employed in formulation of the algorithm of particle macrostructure and in the interpretation of the power law fragment number distribution at high conversion. 15 refs.

0150 Marketing And Economics

REFER ALSO TO CITATION(S) 20885, 20886, 20887, 20922, 20930

0160 Health And Safety

REFER ALSO TO CITATION(S) 20877

20954 (DOE/ER/60493—1-Vol.3, pp 8-14) **Lung cancer and indoor exposure of unvented coal and wood combustion emissions in Xuan Wei, China.** Mumford, J.L.; Chapman, R.S.; Harris, D.B.; He, X.Z.; Cao, S.R.; Xian, Y.L.; Li, X.M. (Environmental Protection Agency, Research Triangle Park, NC). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Residents of Xuan Wei County in China have unusually high lung cancer mortality that cannot be attributed to tobacco use or occupational exposure. They are exposed to smoke from unvented, open pit coal or wood fires (often used for cooking and heating). The variation in lung cancer rates among communes within the country suggests that indoor combustion of smoky coal may be the prime determinant of lung cancer. To characterize the air in Xuan Wei homes, samples of the air particles and semivolatile organics were collected from homes located in communes with different lung cancer rates. Samples collected in the commune in which the lung cancer rate is high and smoky coal is the predominant fuel contained high concentrations of submicron particles with high organic content; organic extracts of these samples were mutagenic. Samples from homes in a wood-burning commune, which has a low lung cancer rate, consisted mostly of large particles of lower organic content and mutagenicity. The smoky coal sample was also a more potent skin tumor initiator compared to the wood or smokeless coal sample and was a mouse skin carcinogen.

20955 (DOE/ER/60493—1-Vol.3, pp 20-24) **Effects of cooking fuels on respiratory symptoms, lung functions, and carboxyhemoglobins of non-smoking women.** Liu, L.; Wang, L.H. (Beijing Medical Univ., China). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

40-65 year old non-smoking women were analyzed of the effects of exposure at home to coal or gas on their respiratory symptoms, lung functions and carboxyhemoglobins(HbCO). The results showed that the use of coal as cooking fuel was associated with high concentrations of SO_2 and CO, and low concentration of NO_2 in the households when compared with the use of gas. The women using coal as cooking fuel had a higher prevalence of respiratory symptoms, and higher HbCO after adjustment of some confounding factors. With the increase of consuming coal or gas, FEV1.0/VC, FEV1.0/FVC, PEF, MEF75, MEF50 and MEF25 were lowered, but FEV1.0/VC and PEF seemed related more with burning coal, and MEF75 and MEF50 more with gas. Our studies suggested that using coal stoves is a dangerous factor to people's respiratory system. But, potential damage in people's small air way induced by NO_2 after using gas stoves should not be neglected.

02 PETROLEUM

0202 Geology And Exploration

REFER ALSO TO CITATION(S) 21381, 22818

0203 Drilling And Production

20956 (AEEW-R—2035) Bulk rheology of xanthan/chromium gels. Hubbard, S.; Gannon, E. (UKAEA Atomic Energy Establishment, Winfrith). Nov 1987. 24p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

A study has been made of the kinetics of formation of bulk xanthan gels. Chromium (III) ions have been used to cause cross-link formation leading to polymer gelation. Two instruments have been used, a constant shear rate rotational viscometer and a pulse shearometer. Shear accelerates the gelation reaction by a factor of about 6. In the shear rate range studied, however, 0.36 to 14s/sup -1/, there is no variation of gel time with shear rate. Although shear increases the reaction rate by increasing the number of molecular collisions it also mechanically degrades the gel that forms. Although chromium is in excess above about 20 ppm (for 800 ppm xanthan) the chromium concentration is a rate determining step in the gelation reaction even for concentrations of several hundred ppm. Xanthan concentration does not influence the reaction rate but the eventual strength of a gel depends strongly on the xanthan concentration. Acidity had only a small effect in the pH range 4 to 5.

20957 (AEEW-R—2158) Investigation into the temperature variation of the gel time xanthan/chromium mixtures. Johnston, J.D.; Hubbard, S. (UKAEA Atomic Energy Establishment, Winfrith). Nov 1987. 22p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

The variation of gel time with temperature has been examined in the range 20 - 40/sup 0/C for the gelling system xanthan/chromium (III). Two complementary techniques have been used; oscillatory rheometry and rotational viscometry. An improved method of mixing reagents has been used to increase the reproducibility of gel time determinations. For both measurement techniques it has been found that log (gel time) varies linearly with inverse temperature. This relationship may be used to predict gel times at other temperatures.

20958 (AEEW-R—2159) Effect of acidity and buffer systems on polymer gelation. Johnston, J.D.; Hubbard, S. (UKAEA Atomic Energy Establishment, Winfrith). Nov 1987. 10p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

An investigation has been made into bulk gelation, giving particular attention to acidity and its control by buffer systems. It was found that the choice of buffer is critical because the buffer components interfere with the gelation reaction. The bulk gelation results do not always agree with porous media work which suggests that surface reactions may be an important aspect of the gelation process in a rock matrix.

20959 (DOE/BC—88/2/SP) BOAST II: A three-dimensional, three-phase black oil applied simulation tool. Fanchi, J.R.; Kennedy, J.E.; Dauben, D.L. (K and A Technology, Tulsa, OK (USA)). Dec 1987. 410p. NTIS, PC A18/MF A01; 1; GPO Dep. Order Number DE88001205/JAW.

A Three-Dimensional, Three-Phase Black Oil Applied Simulation Tool (BOAST) (Version 1.1) was released by the Department of Energy in the fall of 1982. This program has been extensively used by various research, academic, and industry organizations. BOAST has proven to be popular because it is very easy to use and is not burdened by seldom-used features which complicate and slow the execution of the program. It has even been successfully used on disk-top computers. In spite of its wide-scale use, complications have developed in some applications. Most of the problems have occurred when the program was used for field-scale conditions where it was not suitable in its original form. BOAST II was developed to overcome some of the limitations of the original BOAST. The main thrust has been to keep the program uncomplicated and easy to use, yet add features which would improve its versatility. The amount of the code in BOAST II is roughly three times that of the original BOAST. This report discusses the major enhancements of BOAST II related to the original BOAST.

20960 (DOE/BC/10844—10) Polymers for mobility control in enhanced oil recovery: Second annual report, October 1986-September 1987. McCormick, C.L.; Hester, R.D. (University of Southern Mississippi, Hattiesburg (USA). Dept. of Polymer Science). Dec 1987. Contract AC19-85BC10844. 219p. NTIS, PC A10/MF A01; 1; GPO Dep. Order Number DE88001207/JAW.

Research during FY-87 has focused on synthesis and characterization of copolymers with intra- or intermolecular associations. Associative copolymers of acrylamide with N-alkylacrylamides, ampholytic copolymers of NaAMPS and AMPDAC, and micelle forming copolymers with PDAAM have shown unique rheological properties which can be varied by changing microstructure. Dilute-solution studies as well as rheological studies have been conducted on these associative systems in order to probe molecular interactions. Such studies indicate significant potential advantages of these systems in EOR applications. Size exclusion chromatography and dynamic light scattering analysis techniques are being developed concurrently so that EOR polymer molecular weight distributions can be measured. Individual projects are processed separately for the Energy Data Base. (CBS)

20961 (DOE/FE/60600—T16) UONPR No. 1, Elk Hills, 26R Reservoir, Elk Hills oil and gas field, Kern County, California: Management Review: Surface operations and measurements of production and injection volumes. (Evans, Carey and Crozier, Bakersfield, CA (USA)). [1987]. Contract AC01-85FE60600. 98p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88004511/JAW.

Evans, Carey and Crozier was given the task to conduct a Management Review of the Surface Operations of the 26R Reservoir in UONPR No. 1, Elk Hills field, Kern County, California. The MER strategy for this reservoir is to maintain pressure, and toward this end, gas injection volumes are scheduled to amount to 110% of calculated withdrawals. In spite of this, however, reservoir pressure continues to decline. The purpose of this study was, therefore, to determine if, and to what extent, field operating practices and accounting procedures may be contributing to this dilemma and to make appropriate recommendations pertaining to correcting any deficiencies which may have been found.

20962 (NIPER—260) National Institute for Petroleum and Energy Research: FY88 annual research plan. (National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA)). Oct 1987. Contract FC22-83FE60149. 165p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE87001261/JAW.

This is the fifth Annual Research Plan for the National Institute for Petroleum and Energy Research (NIPER). In its program of long-range research, NIPER is preparing for the time when petroleum scarcities again plague the United States. Two general study areas are addressed: (1) The consolidation and extension of enhanced oil recovery (EOR) technology. This includes reservoir characteriztion, chemical flooding, gas injection, steam injection, and microbial EOR. (2) The development and improvement of knowledge concerning the manufacture and use of fuels from less desirable feedstocks. This includes the study of heavy petroleum, heavy ends of petroleum, tar sands, shale oil, and coal liquids.

20963 Fracturing and testing case study of paludal, tight, lenticular gas sands. Warpinski, N.R.; Branagan, P.T.; Sattler, A.R.; Lorenz, J.C.; Northrop, D.A.; Mann, R.L.; Frohne, K.H. (Sandia Natl. Labs.). *SPE (Society of Petroleum Engineers) Formation Evaluation;* **2**: No. 4, 535-545(Dec 1987).

This paper is a case study of the stimulation and testing of tight, lenticular sands in the paludal interval of the Mesaverde

group in the Piceance basin at DOE's Multiwell Experiment (MWX) site in Colorado. Topics discussed include geologic data, stress test results, well testing, laboratory core studies, stimulation and stimulation analyses, and postfracture operations.

20964 **Geologic problems related to characterization of clastic reservoirs for EOR.** Szpakiewicz, M.; McGee, K.; Sharma, B. (Natl. Inst. for Petroleum and Energy Research). *SPE (Society of Petroleum Engineers) Formation Evaluation;* **2**: No. 4, 449-460(Dec 1987).

Geologic problems encountered in four U.S. DOE-sponsored EOR projects in clastic reservoirs were analyzed. The reservoir heterogeneities were grouped into four categories: depositional, diagenetic, structural, and formation-fluid composition/distribution. Each category had a variable effect on the performance of the EOR projects. Requirements for developing one static geologic model for each category of heterogeneity are proposed. The interrelationship of geologic factors and the effect of heterogeneities resulting from the origin and timing of geologic events are described. Besides heterogeneities associated with the depositional environment, which has a significant effect on EOR performance, diagenetic effects resulting from geochemical alterations and different types and polymorphs of clays are also important but are often neglected. The structural component of the model needs to be improved through the application of new methodology or improvements in existing technology (e.g., remote sensing, high-resolution seismic). A realistic prediction of fluid movement in clastic reservoirs subjected to EOR requires the integration of the four models that define all the heterogeneities.

20965 **Effect of interfacial viscosities upon displacement in sinusoidal capillaries.** Giordano, R.M.; Slattery, J.C. (Dept. of Chemical Engineering, Northwestern Univ., Evanston, IL 60201). *A.I.Ch.E. Journal (New York);* **33**: No. 10, 1592-1602(Oct 1987).

This quantitative analysis shows the relative effects of interfacial tension, interfacial viscosities, and wetting during displacement in a capillary whose radius is a sinusoidal function of axial position. The effect of the interfacial viscosities is to increase the resistance to displacement regardless of the wetting condition. The results are consistent with a previous qualitative analysis and with a previous quantitative analysis for displacement in capillaries whose radii are independent of axial position. In screening surfactant systems for potential use in tertiary oil recovery, it is recommended that the interfacial tension be minimized first, since it determines whether oil displacement will occur, and that the interfacial viscosities be minimized second, since they influence the rate of oil displacement.

20966 **Hydrate dissociation in sediment.** Selim, M.S.; Sloan, E.D. (Colorado School of Mines). pp 243-258 of Proceedings of the 1987 annual technical conference and exhibition: General petroleum engineering. Richardson, TX; Society of Petroleum Engineers (1987). (CONF-870913—).

From Annual technical conference and exhibition of the Society of Petroleum Engineers; Dallas, TX, USA (27 Sep 1987).

Technical Paper SPE 16859.

A physical model that describes hydrate dissociation under thermal stimulation in porous media is presented. The model views the dissociation as a process whereby gas and water are produced at a moving dissociation boundary. The latter separates the dissociated zone which contains gas and water from the undissociated zone which contains the hydrate. A similarity solution to the conservation equation is derived, and results therefrom are presented in graphical forms which are useful in numerical computations. In particular, heat fluxes, temperature profiles, and gas pressure distributions are presented for two cases which simulate saturated steam and hot water thermal stimulation. A parametric study was also made which showed that the rate of dissociation is a strong function of the thermal properties of the system and the porosity of the porous medium. The energy efficiency of the dissociation process, defined as the ratio of the heating value of the gas produced relative to the heat input, was also computed. For hydrate thermal stimulation, an average energy efficiency value of about 9 was found which appears encouraging insofar as natural gas production from hydrates is concerned.

20967 **Weeks Island "S" Sand Reservoir B gravity stable miscible CO/sub 2/ displacement Iberia Parish, Louisiana.** Perry, G.E.; Kidwell, C.M. (Shell Oil Co., P.O. Box 60123, New Orleans, LA 70160). pp 401-415 of Miscible processes II. Richardson, TX; Society of Petroleum Engineers (1985).

Shell Oil Company in conjunction with the Department of Energy is conducting a gravity stable displacement field test of the miscible CO/sub 2/ process. The test is being conducted in a 12,800-foot deep Gulf Coast reservoir. Injection of the CO/sub 2/ slug at the producing gas-oil contact commenced in October 1978. The slug of CO/sub 2/ is being moved downward by production of downdip water. Injection of the 50,000-ton slug should be completed in late 1979. Neutron logging devices are being used to monitor the CO/sub 2/ movement in the vicinity of the observation well. The logs have been successful in detecting CO/sub 2/ and it subsequent movement at the observation well. Qualitative estimates of CO/sub 2/ saturations have been made using these neutron logs.

0204 Processing

REFER ALSO TO CITATION(S) 20802, 20962, 20993

20968 (EUR—11038, pp 149-172) **Outlook for the refining industry in the Community and trade in petroleum products.** de Bauw, R. 1987. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88920165/JAW. (CONF-8703233—).

From EC/OAPEC/OPEC seminar; Luxembourg, Luxembourg (17 Mar 1987).

The industry is coming to the end of a protracted period of adaptation to a market for petroleum products greatly reduced in size and much changed in composition and in which imports of finished products have a larger share. Restructuring has required many refinery closures and substantial programs of investment at those remaining in service; capacity for primary distillation has fallen by one third while that for conversion has more than doubled. With utilization approaching 80%, Community capacity and demand are now restored to reasonable balance, although some further rationalization remains to be done in a number of Member States. The industry is now moving into a phase where the emphasis is upon meeting more exacting product-quality requirements in the interests of environmental protection. The outlook for industry profitability looks better than for some years thanks to the prospect of some demand growth, to the reduction of unit costs and improvement of product yields brought about by rationalization and investment, and to the probable tightness in the supply of unleaded gasoline and low-sulfur gasoil and fuel oil. 12 figures, 15 tables.

20969 **(NIPER—280) Catalytic cracking of Mayan gas oil and selected hydrotreated products: Topical report.** Wells, J.W.; Zagula, E.J.; Brinkman, D.W.; Anderson, R.P. (National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA)). Jan 1988. Contract FC22-83FE60149. 42p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001212/JAW.

The catalytic cracking of a Mayan vacuum gas oil and the products from mild, moderate, and severe hydrotreating of this gas oil was evaluated over a low-metal equilibrium catalyst in a microconfined bed unit (MCBU). Results obtained with the Mayan feedstocks are compared with those of an earlier study conducted with similar feedstocks obtained from a Wilmington (CA) crude oil. Two levels of catalytic cracking severity were used in the evaluation. Performance and product analysis showed that hydrotreating improves the yields obtained from catalytic cracking and the quality of the resultant products. In contrast to results obtained with the Wilmington feedstocks, conversion and gasoline yield do not improve with severity of the hydrotreating of the Mayan vacuum gas oils. The insensitivity of the cracking performance to hydrotreating severity may reflect the more facile removal of polar compounds (heteroatom compounds) on hydrotreating of the Mayan gas oil in comparison to the Wilmington. Sulfur and nitrogen contents of the liquid products (gasoline, light cycle oil, heavy cycle oil) decreased as the severity of the feed hydrotreating increased. 7 refs., 12 figs., 15 tabs.

20970 **(UCRL—97248-Pt.1-Rev.1) Effect of prehydrogenation on hydroconversion of Maya residuum, Part 1: Process characterization.** Reynolds, J.G.; Beret, S. (Lawrence Livermore National Lab., CA (USA); Chevron Research Co., Richmond, CA (USA)). Oct 1987. Contract W-7405-ENG-48. 25p. (CONF-871176—1-Pt.1-Rev.1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002581/JAW.

From Annual meeting and conference on biotechnology; New York, NY, USA (15 Nov 1987).

Maya 650°F residuum was mildy prehydrogented over a standard, commercially available, hydrodesulfurization catalyst. The product was then distilled to yield hydrogenated Maya 650°F residuum. This prehydrogenated residuum, and the untreated Maya 650°F residuum were separately hydroprocessed further at different process severities. The resulting products were then examined by elemental analyses to determine the effects of the prehydrogenation step on overall conversion and product quality. 38 refs., 4 figs., 6 tabs.

0205 Products And By-products

REFER ALSO TO CITATION(S) 21935, 22983

20971 **(PB—88-856059/XAB) Aviation fuel additives. January 1970-December 1987 (citations from the NTIS data base). Report for January 1970-December 1987.** (National Technical Information Service, Springfield, VA (USA)). Jan 1988. 96p. NTIS PC N01/MF N01.

Supersedes PB—86-868700.

This bibliography contains citations concerning research and development of aviation fuel additives, together with pertinent characteristics. Included are studies on antioxidants, antimist, antistatic, lubricity, corrosion inhibition, and icing inhibition additives. Other characteristics are covered in investigations into additives for vulnerability reduction, thermal stability, and storage stability of aviation fuels. (This updated bibliography contains 171 citations, 11 of which are new entries to the previous edition.)

0207 Marketing And Economics

REFER ALSO TO CITATION(S) 20996

20972 **(DOE/EIA—0208(88-01)(88-02)) Weekly petroleum status report: Data for weeks ended: December 25, 1987, January 1, 1988.** (USDOE Energy Information Administration, Washington, DC). 6 Jan 1988. 35p. NTIS, PC A03/MF A01 - GPO; 1; GPO Dep. Order Number DE88005770/JAW.

The Weekly Petroleum Status Report (WPSR) provides timely information on the context of historical information, selected prices, and forecasts. The WPSR is intended to provide up-to-date information to the industry, the press, planners, policymakers, consumers, analysts, and State and local governments. It is published each Thursday by the Energy Information Administration (EIA). The data contained in this report are based on company submissions for the week ending 7 a.m. the preceding Friday.

20973 **(DOE/EIA—0380(87/11)) Petroleum marketing monthly, November 1987.** (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). 1 Feb 1988. 166p. NTIS, PC A08/MF A01 - GPO; 1; GPO Dep. Order Number DE88005772/JAW.

Information and statistical data about a variety of crude oils and refined petroleum products are given. The publication provides statistics on crude oil costs and refined petroleum products sales for use by industry, government, private sector analysts, educational institutions, and consumers. Data on crude oil include the domestic first purchase price, the f.o.b. and landed cost of imported crude oil, and the refiners' acquisition cost of crude oil. Sales data for motor gasoline, distillates, residuals, aviation fuels, kerosene, and propane are presented. 12 figs., 53 tabs.

20974 (EUR—11038, pp 79-97) **Energy-policy responses, strategies, and planning in the oil-exporting countries.** Samii, M.V.; Idemudia, T. 1987. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88920165/JAW. (CONF-8703233—).

From EC/OAPEC/OPEC seminar; Luxembourg, Luxembourg (17 Mar 1987).

This paper discusses the past developments and the present conditions of the oil market, emphasizing the structural changes that have led to the sharp decline in OPEC's production and share in the world oil supply and the difficulties that the Organization faces in maintaining order in this market. It also analyzes the consequences of the oil price gyration and particularly the price decline of 1986. Moreover, it considers various issues related to the oil-market stability and measures that are required to maintain order in this market. It is pointed out that the events of 1986 were the result of a number of factors such as the steady changes in the supply and demand patterns since the mid-1970s, particularly the growth of high cost non-OPEC supplies at the expense of OPEC oil, the policy measures of consuming countries in respect of substitution, conservation and taxation of petroleum products and, in some cases, taxation of imported crude. The major aim of OPEC's policy has been to ensure an equitable export income for Member Countries commensurate with the value and depletable nature of crude oil on the one hand and the financial requirements of their socio-economic development on the other hand. 13 figures, 2 tables.

20975 (EUR—11038, pp 100-128) **Oil market situation: the impact on the economic development of the oil-exporting countries.** Hammoudeh, S. 1987. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88920165/JAW. (CONF-8703233—).

From EC/OAPEC/OPEC seminar; Luxembourg, Luxembourg (17 Mar 1987).

This paper provides an empirical analysis of the impact of instability of oil-export earnings on the economic development of six selected oil-exporting countries. It deals with this issue in three parts: the first part tests degree of instability of the values of oil exports for the selected countries; the second tests the causal relationship between changes in GNP and changes in oil exports; and the third examines the impact of instability on economic growth of these countries. 32 references, 9 tables.

20976 (EUR—11038, pp 129-138) **Oil-market situation: its impact on future energy supplies.** Desprairies, P. 1987. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88920165/JAW. (CONF-8703233—).

From EC/OAPEC/OPEC seminar; Luxembourg, Luxembourg (17 Mar 1987).

The effects of the drop in oil prices on future energy supplies on a world scale are analyzed. The effects depend on the level at which the oil prices becomes stabilized and on the number of years during which the price remains low. This hypothesis is chosen: a price fluctuating unpredictably until 1990 or 1995, between $10 and 30, but for which the level over the next five to ten years should be around $15, after which it should rise gradually to about $25 toward the end of the century. This last price is retained as a reasonable compromise between the need to sell by the major producing countries in the Middle East and the need to produce by other countries in the world, so that they can balance their external accounts and ensure the security of their supplies.

20977 (EUR—11038, pp 140-148) **Outlook for the refining industries and trade in oil products in OAPEC and OPEC member countries.** Alwattari, A. 1987. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88920165/JAW. (CONF-8703233—).

From EC/OAPEC/OPEC seminar; Luxembourg, Luxembourg (17 Mar 1987).

The future impact of refineries in OAPEC/OPEC members will depend on the size of the surplus they will have. It is generally agreed that the bulk of the construction and expansion is largely in place and that comparatively little capacity will be added in the next few years. Nevertheless, internal demand is expected to increased by about 50% in the next eight years. That is, the combined OAPEC/OPEC consumption will be 6.0 million b/d in 1995,

compared with 3.8 million b/d in 1985/86. The expected increase of more than 2 million b/d in OAPEC/OPEC demand compared with the expected expansion in refining of 1 million b/d indicates a decline in the quantity of exportable products over this period by about 1 million b/d. Product exports from OAPEC/OPEC members are expected to be 1.6 million b/d in 1995, versus 2.6 million b/d in 1985/86. Some of these exports will be destined for markets in the developing countries and the centrally planned economy countries. 4 tables.

20978 (EUR—11038, pp 173-206) **Final panel - world energy balance: interdependence and international cooperation.** 1987. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88920165/JAW. (CONF-8703233—).

From EC/OAPEC/OPEC seminar; Luxembourg, Luxembourg (17 Mar 1987).

The seminar was concluded by a final panel of representatives from the oil, financial, and academic communities. It was felt that, despite the divergence of interest, there was consensus that excessive price fluctuations are damaging to both consumers and producers. The difference between the short-term weak-market advantages and longer-term benefits was stressed. More work and further analysis were recommended to clarify the problems for all actors on the energy scene.

20979 **(GRI—87/0003) Competitive position of natural gas: High-temperature fluid heating in petroleum refining and chemicals manufacturing: Topical report.** Holmes, J.G.; Olsen, K.G. (Energy and Environmental Analysis, Inc., Arlington, VA (USA)). Dec 1986. 166p. NTIS, PC A08/MF A01. Order Number DE88900255/JAW.

In petroleum refining, fluid heating represents 65% of the total fossil fuel use. By-product process off-gas is the primary fuel used in refining and natural gas is the preferred purchased fuel, representing one-quarter of the total fossil fuel use. In chemical manufacturing, fluid heating accounts for about one-third of total fossil fuel use (excluding feedstocks). Its use is concentrated in the manufacturing of major petrochemical intermediates (ethylene, propylene, ammonia and methanol). As in the refining sector, natural gas is the preferred energy source for chemical fluid heating. This study provides insights into the technological and important factors influencing the future competitiveness of natural gas-fueled fluid heating technologies. The report focuses on the performance factors influencing the fuel and heater equipment selection. It relates these performance factors to the capabilities of existing gas-fired equipment and to the requirements likely to be placed on new gas technologies. Specific data and results presented in the report are useful to R & D managers, technology developers, and gas utility service representatives and planners.

20980 **(NEDO-P—8523) Econometric analysis of oil-substituting energy.** (New Energy Development Organization, Tokyo (Japan)). Mar 1986. 228p. (In Japanese). NTIS (US Sales Only), PC A11. Order Number DE88770057/JAW.

A demand forecasting model by uses of energy was developed to analytically estimate the introducible amounts of new energies by the sectors in which each new energy would take part. Especially, the demands were classified by the uses and estimated. The simulation results of the amount of each new energy introduced indicate that the amounts of new energies introduced in 2010 will be 2.6, 2.7 and 3.1% of the total energy in the scenarios of the annual increasing rate of energy price of 1, 2 and 3%, respectively, at the annual inflation rate of commodities of 2%. In the second scenario assuming that the increasing rate of the prices of commodities and energy are equal, solar application, solar cells and fuel cells will penetrate into the marketplace from now to 2000 and the oil-substituting fuel for automobile will begin to be used in 2000. The new energies introduced in the industry, public and transportation sectors in 2010 will account for 3.3, 3.3 and 1.0%, respectively, of the total energy. (50 figs, 71 tabs)

20981 **(OCS/MMS—87-0078) Outer Continental Shelf oil and gas activities: Pacific summary/index, June 1, 1986-July 31, 1987.** (Minerals Management Service, Vienna, VA (USA). OCS Information Program). 1987. 169p. Minerals Management Service, P.O. Box 101159, Anchorage, AK 99510. Order Number TI88900286/JAW.

The Outer Continental Shelf Oil and Gas Information Program (OCSIP) was established in 1978 in compliance with a mandate of the Outer Continental Shelf (OCS) Lands Act. Information on OCS oil and gas activities and related issues is regularly published by OCSIP. This information is in two types of documents: regional summary reports and indexes. This publication discusses the following topics: offshore oil and gas resources of the Pacific region; offshore developments; project-specific developments and status; local issues; and national issues. 8 refs., 18 figs., 29 tabs.

20982 **(PB—88-142484/XAB) US oil production: the effect of low oil prices. Special report.** (Office of Technology Assessment (U.S. Congress), Washington, DC). Sep 1987. 140p. (OTA-E—348). NTIS, PC A07/MF A01.

Also available from Supt. of Docs. See also report dated Jul 87, PB—87-217733; Library of Congress catalog card no. 87-619846.

This report contains a review of the effect of volatile oil prices on U.S. domestic oil production. It presents an analysis conducted by the Office of Technology Assessment, Congress of the United States, (OTA) of a group of factors believed to strongly influence the future direction of U.S. oil production. These factors include the expected profitability of new investments in drilling, the potential of new oil exploration, development, and production technologies, the nature of the remaining oil-resource base, and structural changes in the oil industry. The report also provides a brief discussion of some policy options for Congress to consider if it decides to moderate the expected accelerated decline in U.S. oil production.

0208 Waste Management

REFER ALSO TO CITATION(S) 22569

0209 Environmental Aspects

REFER ALSO TO CITATION(S) 22751, 22802

20983 **(EGG—10282-2174) Annual summary of endangered species preconstruction surveys conducted during 1986 on Naval Petroleum Reserve No. 1 (NPR-1), Kern County, California.** Kato, T.T. (EG and G Energy Measurements, Inc., Goleta, CA (USA). Santa Barbara Operations). Jul 1987. Contract AC08-83NV10282. 49p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006092/JAW.

Preconstruction surveys were implemented as part of the US Department of Energy's compensation/mitigation plan to offset possible effects of petroleum developments on the endangered San Joaquin kit fox and blunt-nosed leopard lizard, and the proposed endangered giant kangaroo rat. These surveys were conducted to gather information that could be used to assess potential impacts of construction activity on endangered species and their habitats, and to formulate alternatives that resulted in avoiding or minimizing the effects. During 1986 a total of 130 preconstruction surveys covering approximately 665 acres were conducted. Approximately 273.5 acres of the area surveyed were subsequently disturbed by construction or maintenance activities. A total of 45 kit fox dens, numerous giant kangaroo rat burrow systems, and 47 washes representing habitat for blunt-nosed leopard lizards were found. Three kit fox dens and one wash were not considered to be threatened by construction, but all giant kangaroo rat burrows were. Impacts to 41 kit fox dens, all of the burrows, and 46 of the washes were avoided by 27 project modifications. One den was excavated to prevent potential burial of a kit fox or other wildlife during construction. 10 refs., 1 fig., 2 tabs.

20984 **(EGG—10282-2178) Operational guidelines for conducting endangered species preactivity surveys on Naval Petroleum Reserve No. 1, Kern County, California.** Kato, T.T.; O'Farrell, T.P. (EG and G Energy Measurements, Inc., Goleta, CA (USA). Santa Barbara Operations). Jul 1987. Contract AC08-83NV10282. 38p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88006129/JAW.

Endangered species preactivity surveys are an essential element of the US Department of Energy's commitment to conserve endangered species and their habitats. They have successfully been used to avoid direct impacts and to reduce the likelihood of incidental take of endangered species. These guidelines are provided to outline the steps required to successfully implement and carry out preactivity surveys. The guidelines consist of a dichotomous decision table, flowchart, and accompanying explanatory text. The main steps include determining if a preactivity survey is required, how to handle emergency situations, information requirements, survey methods, data recording, impact assessment criteria, resolving conflicts, project changes and timetables, reporting requirements, follow-up surveys, and documentation. 15 refs., 1 fig., 2 tabs.

20985 **(EGG—10282-2179) Evaluation of habitat restoration on the Naval Petroleum Reserve No. 1, Kern County, California.** Anderson, D.C. (EG and G Energy Measurements, Inc., Goleta, CA (USA). Santa Barbara Operations). Aug 1987. Contract AC08-83NV10282. 107p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88006116/JAW.

The habitat restoration program on Naval Petroleum Reserve # 1 (NPR-1) began with the revegetation of approximately 121 acres of disturbed lands in 1985 and continued in 1986 with the revegetation of an additional 112 acres. A revegetation monitoring program was developed and implemented in the spring of 1987 with the objectives of evaluating the success of the current program and providing needed information on techniques and methodologies. During the spring of 1987, 430 sites that had been revegetated in 1985 or 1986 were evaluated qualitatively. The amount of vegetative cover and plant density by species along with other quantitative information was taken at 100 of the revegetation sites. Soil samples were taken at each revegetation site and analyzed for salts and content of various elements of concern. Results of the sampling show 45% vegetative cover on sites revegetated in 1985 and 21% cover on 1986 sites. Composition of the total cover was primarily annual forbs and grasses (96% on 1985 sites and 98% on 1986 sites). Plant density was 30.2 plants/ft^2 on sites revegetated in 1985 and 16.4 plants/ft^2 on 1986 sites. Soil analysis reveals high amounts of salts and low organic matter content for many of the soils sampled. The only elements with levels considered to be in the toxic range were barium and molybdenum. 8 refs., 5 figs., 16 tabs.

20986 **(EGG—10282-2188) Diet of the blunt-nosed leopard lizard, Gambelia silus, on Naval Petroleum Reserves No. 1 and No. 2, Kern County, California.** Kato, T.T.; Rose, B.R.; O'Farrell, T.P. (EG and G Energy Measurements, Inc., Goleta, CA (USA). Santa Barbara Operations). Sep 1987. Contract AC08-83NV10282. 23p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005672/JAW.

A preliminary inventory of the prey consumed by the endangered blunt-nosed leopard lizard (Gambelia silus) was conducted by analysis of prey fragments present in scat collected during 1982 and 1984. Information on the diet of this species and a method to collect serial samples without sacrificing individuals were needed before an assessment of the potential effects of Malathion spraying to control the beet leafhopper (Circulifer tennelus) could be conducted. The study indicated that analysis of scats can accurately determine the diet of this endangered species. The diet of blunt-nosed leopard lizards as determined from 16 scats in order of numerical importance was: grasshoppers (orthropterans) (54.5%), bees (hymenopterans) (18.2%), true bugs (hemipterans) (16.7%), beetles (coleopterans) (4.5%), and lizards (4.5%). These results are similar to those reported by Tollestrup (1979) and Montanucci (1965, 1967) in the high proportion of diet consisting of insects. Results confirmed that vertebrates are sometimes consumed by blunt-nosed leopard lizards, as was reported by Montanucci (1967); Tollestrup (1979) found no vertebrate remains in stomachs. The combination of scat analysis and monitoring by radiotelemetry provided techniques which will permit collecting sufficient data to determine whether pest control programs negatively affect blunt-nosed leopard lizards.

20987 **(EGG—10282-2190) Dispersal of San Joaquin kit foxes, Vulpes macrotis mutica, on Naval Petroleum Reserve No. 1, Kern County, California.** Scrivner, J.H.; O'Farrell, T.P.; Kato, T.T. (EG and G Energy Measurements, Inc., Goleta, CA (USA). Santa Barbara Operations). Sep 1987. Contract AC08-83NV10282. 42p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006091/JAW.

Between 1980-1986, the movements of 332 pups and 267 adult San Joaquin kit foxes (Vulpes macrotis mutica) were analyzed to determine which animals had dispersed. Of 129 foxes radiocollared as pups and whose parental den ranges were known, 48 (33 males, 15 females) dispersed; about 51% dispersed between July-September, and all but 11 dispersed as pups. There was no sex-specific difference in the average date that dispersal commenced. The number of days between dispersal and death was greater for pups that delayed dispersing until they became adults. Of the 90 radiocollared adults, 23 (14 males, 9 females) dispersed. Adults were found dispersing nearly equally in all months. Foxes less than 1 y old dispersed more frequently than older animals. When dispersal distances of radiocollared pups and adults were combined, no sex-specific differences were found in the average dispersal distance of 4.0 +- 0.5 miles. However, pups dispersed 5.0 +- 0.9 miles, while adults dispersed 3.0 +- 0.5 miles. An adult male traveled 29 miles. No evidence gathered demonstrated that petroleum development activities were responsible for a tendency for more foxes to disperse from developed habitat than from undeveloped habitat. Of the dispersing radiocollared foxes that were recovered dead, 47.9% were killed by predators, 15.1% were killed by vehicles, 1.4% died from other causes, and 35.6% died from unknown causes. These proportions were similar to those observed for nondispersers. 35 refs., 3 figs., 15 tabs.

20988 **(PB—88-139613/XAB) Response of the phoxocephalid amphipod, Rhepoxynius abronius, to a small oil spill in Yaquina Bay, Oregon.** Kemp, P.F.; Swartz, R.C.; Lamberson, J.O. (Environmental Protection Agency, Newport, OR (USA). Mark O. Hatfield Marine Science Center). 1986. 10p. (EPA—600/J-86/417). NTIS, PC A02/MF A01.

Pub. in Estuaries, Vol. 9, No. 4B, 340-347(Dec 1986).

A spill of approximately 284,000 liters of Bunker C and diesel fuel oils occurred at the entrance of Yaquina Bay, Oregon, following the wreck of the freighter Blue Magpie on 19 November 1983. A portion of the oil entered the lower estuary and was deposited on subtidal benthic habitats occupied by the phoxocephalid amphipod Rhepoxynius abronius. The species is particularly sensitive to contaminants in sediment and its life history had previously been studied at the same sites affected by the spill. The oil was initially present as small, sand-coated globules at the study site, and persisted in association with detritus and sediment for months. Bioassays with Rhepoxynius abronius showed that the oil globules were not acutely toxic unless mixed into the sediment at concentrations of 1.0 parts per thousand or greater. A series of 10-d bioassays before and after the spill showed that sediment collected from oiled subtidal sites did not become acutely toxic to the species.

20989 **(PB—88-139639/XAB) Pulmonary effects due to short-term exposure to oil fog.** Selgrade, M.K.; Hatch, G.E.; Grose, E.C.; Illing, J.W.; Snead, A.G. (Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab.). 1987. 15p. (EPA—600/J-87/094). NTIS, PC A03/MF A01.

Pub. in Jnl. of Toxicology and Environmental Health, Vol. 21, 173-185(1987).

Rats were exposed to an oil fog generated by flash vaporization and subsequent condensation of light-weight lubricating oil. Exposures were for 3.5 hrs/day, 4 days/wk, for 4 wks, at concentrations of 1.5, 0.5, or 0.1mg/1 and a particle size of approximately 1 micronole. Samples of respiratory tissues were taken for histopathologic analyses, lavage fluid samples were collected, and pulmonary function measurements were made the day after the last exposure. An accumulation of macrophages within the alveolar lumen, an increase in lavage fluid protein content, and an increase in total cell content in lavage fluid due to an influx of polymorphonuclear leukocytes was noted in rats exposed at the 1.5 mg level. Also, for the exposure group there was an increase in lung wet and dry weight, and an increase in end expiratory volume, and

pneumonitis was observed histopathologically in 4 of 10 male rats exposed. Pneumonitis was not observed among 6 female rats examined. Oil fog had no effect on total lung capacity, residual volume, vital capacity, lung compliance, or the distribution of ventilated air within the lung. Effects following exposure to 0.5 mg/1 were limited to slight accumulation of macrophages in the alveolar lumen and an increase in the total cells in lavage fluid which could not be attributed to an increase in any particular cell type.

20990 **(PB—88-145933/XAB) Salt-marsh monitoring around Sullom Voe in 1986.** Dalby, D.H.; Tibbetts, P.J.C. (Shetland Oil Terminal Environmental Advisory Group, Aberdeen (UK)). 1987. 53p. NTIS, PC E06/MF E06.

See also PB—82-181157.

Contents include: general summary of salt marsh monitoring in 1986; proposals for future monitoring work; biological monitoring in 1986; chemical monitoring in 1986; conclusions from the biological monitoring program.

20991 **(PB—88-856232/XAB) Oil pollution sampling, detection, and analysis. January 1976-January 1988 (citations from the NTIS data base). Report for January 1976-January 1988.** (National Technical Information Service, Springfield, VA (USA)). Jan 1988. 131p. NTIS PC N01/MF N01.

Supersedes PB—87-853636.

This bibliography contains citations concerning the monitoring and analysis of oil pollution resulting from production and transport operations. Descriptions and evaluations of monitoring methods and devices, tagging and tracing techniques, analytical techniques, including spectroscopy and chromatography, are among the topics reviewed. Remote sensing methods, and oil-laden sediment sampling and analyses are also considered. While the majority of the citations pertain to marine pollution, some attention is given to terrestrial aspects. Citations pertaining specifically to pollution effects on flora and fauna are excluded. (This updated bibliography contains 251 citations, 42 of which are new entries to the previous edition.)

20992 **(PB—88-857594/XAB) Biodeterioration of oil spills. January 1970-January 1988 (citations from the NTIS data base). Report for January 1970-January 1978.** (National Technical Information Service, Springfield, VA (USA)). Feb 1988. 89p. NTIS PC N01/MF N01.

Supersedes PB—82-807371.

This bibliography contains citations concerning the degradation of petroleum products, including hydrocarbons, oil spills, and beach pollution. Microbial degradation of petroleum products on land, on the surface of the water, and underwater are discussed. Composting techniques and genetic engineering to facilitate oil degradation are briefly cited. The effect of cold climates on degradation speeds is studied. (This updated bibliography contains 173 citations, 31 of which are new entries to the previous edition.)

0230 Properties

REFER ALSO TO CITATION(S) 20915, 20962, 20969, 20970, 21443, 22517

20993 **(NIPER—283) Technique development for characterization of metalloorganics in acid-base-neutral fractions of heavy petroleum residues: Topical report.** Pearson, C.D.; Green, J.B. (National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA)). Jan 1988. Contract FC22-83FE60149. 32p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001213/JAW.

A novel approach for the characterization of metallorganic compounds in heavy petroleum residues has been developed. Wilmington 1000° F+ and Mayan 925° F+ residues and hydrotreated products were separated into acid-base-neutral (ABN) fractions by a unique nonaqueous ion-exchange technique developed at NIPER. The metal complexes in the feeds, hydrotreated products and ABN fractions were then characterized by determining the total vanadium and nickel and by measuring the vanadium and nickel porphyrin content of each fraction. Molecular weight distribution profiles of the vanadium and nickel compounds in the feed, 400°C hydrotreated product and corresponding ABN fractions were obtained by size exclusion chromatography/inductively coupled plasma. The majority of the metal appeared to be in non-porphyrinic form. The vanadium and nickel complexes were distributed into all of the ABN fractions. In the feed and the whole hydrotreated products the porphyrin levels decreased as hydrotreating temperatures increased. In contrast to previously reported work, porphyrins do not always decrease when hydrotreated. The amount of porphyrins in certain ABN fractions increased after hydrotreating at moderate temperatures. The Mayan V and Ni complexes were more resistant to hydrotreating than the Wilmington metal complexes; in particular, the high molecular weight Mayan metal complexes were more resistant to hydrotreating than the high molecular weight Wilmington metal complexes. 15 refs., 11 figs., 10 tabs.

20994 **(NIPER—307) The effect of weathering on octane quality for winter-grade and summer-grade gasolines: Final report.** Wares, R.N. (National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA)). Nov 1987. Contract FC22-83FE60149. 62p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88006573/JAW.

Weathering tests were conducted to examine the effects on fuel volatility and octane characteristics. The commercially available gasoline utilized in the study represented a wide geographic distribtuion for both winter and summer fuels. Aging was accomplished by heating the fuel samples to 110° F and maintaining that temperature for 48 hours. Time histories of Reid vapor pressure (RVP) were conducted. Fuel octane evaluations, both MON and RON, were done. Component characterizations by gas chromatography were made to identify components lost during the aging process. The time histories of vapor pressure changes depended to a limited measure on the initial fuel vapor pressure as well as to differences in composition. Butanes and isopentanes were the primary constituents lost due to the weathering. For the most part octane changes due to fuel weathering were minimal. 4 refs., 25 figs., 24 tabs.

20995 **Supercritical fluid chromatographic determination of hydrocarbon groups in gasolines and middle distillate fuels.** Campbell, R.M.; Djordjevic, N.M.; Markides, K.E.; Lee, M.L. (Brigham Young Univ., Provo, UT). *Analytical Chemistry;* **60**: No. 4, 356-362(15 Feb 1988). Contract FG02-86ER60445.

A supercritical fluid chromatographic method to determine the percentage of saturates, olefins, and aromatics in gasolines and middle distillate fuels was developed. A microbore (1 mm i.d.) silica gel column was used to isolate and determine the aromatics, while a silver-ion-loaded strong cation exchange silica gel microbore column was used to separate the saturates from the olefins and aromatics. Olefins were determined by difference or by using a column switching technique which allows complete separation of saturates, olefins, and aromatics in a single run. A mixed mobile phase of 10% CO_2 in SF_6 (mole percent) was used for both columns, and a flame ionization detector provided uniform, linear response of the hydrocarbons, allowing quantitation with minimal calibration. The average absolute error was 1.5%, while the standard deviation of the area percent of the aromatics of one gasoline sample was 0.5%. Analysis times of under 60 min were achieved.

0240 Storage

20996 **(DOE/FE—0084-3) Strategic petroleum reserve: Quarterly report.** (USDOE Assistant Secretary for Fossil Energy, Washington, DC. Office of Petroleum Reserves). 15 Nov 1987. 13p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88004192/JAW.

The August 15, 1987, Strategic Petroleum Reserve Quarterly Report describes activities undertaken with respect to the development of the Reserve during the period April 1, 1987 through June 30, 1987. The program background and major activities of this quarter are briefly discussed. Other topics are site development; oil acquisition; information on the budget and cost of the reserve; and other program items. During the second quarter of 1987, Strategic Petroleum Reserve storage capacity reached 570 million barrels. At Bryan Mound, final corrective leaching was completed in Cavern 5 whose conversion from sweet to sour crude oil storage is proceeding on schedule. At West Hackberry, leaching was completed for

Cavern 115 and proceeded in the four remaining caverns still under development. At the Bayou Choctaw site, Cavern 17 oil fill was initiated; this 10-million-barrel cavern currently contains over five million barrels of oil. At Big Hill, construction has progressed to the point that attainment of leaching capability by the end of September is on schedule. The total inventory of crude oil stored in the Strategic Petroleum Reserve reached 527,186,515 barrels during the quarter ending June 30, 1987. The average fill rate during the quarter was 79,119 barrels per day, and the weighted average delivered price during this quarter was $19.17 per barrel. Funds available for obligation in fiscal year 1987 include $526 million in the SPR Petroleum Account for the acquisition and transportation of crude oil and $262 million in the Strategic Petroleum Reserve Account for activities associated with storage facilities development and the operation and management of the Strategic Petroleum Reserve. Approximately $23 million of Strategic Petroleum Reserve Account funds will be carried over to reduce new budget authority required for the account in fiscal year 1988.

03 NATURAL GAS

0301 Reserves

REFER ALSO TO CITATION(S) 20998, 20999

0302 Geology And Exploration

REFER ALSO TO CITATION(S) 21003, 21004, 22818

0303 Drilling, Production, And Processing

REFER ALSO TO CITATION(S) 20966, 21005, 21006

0305 Health And Safety

REFER ALSO TO CITATION(S) 20955

20997 **(PB—88-160106/XAB) Environment and Safety Research status report: 1986-1987.** (Gas Research Inst., Chicago, IL (USA)). Mar 1987. 173p. (GRI—87/0355). NTIS, PC A08/MF A01.

This document discusses the status of ongoing and planned research activities in GRI's Environment and Safety Research Program for the period 1986-1987. Activities within the program are divided into three subprograms, each having multiple project areas: supply (natural gas and substitute natural gas), end use (indoor air quality and combustion systems emission controls), and gas operations (transport and storage). Each project area is discussed separately within the context of its subprogram. Presented are objectives and goals, accomplishments, strategy and basis for each project area, and a status review sheet for projects within the project area.

0306 Marketing And Economics

REFER ALSO TO CITATION(S) 20972, 20981

20998 **(DOE/IE/10491—T1-Vol.1) Gas in developing countries: Volume 1, Main report.** (Oxford Institute for Energy Studies (UK)). 17 Dec 1987. Contract FG01-86IE10491. 129p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88005798/JAW.

When gas is discovered in a developing country, and there is either insufficient to justify an Liquified Natural Gas (LNG) export project, or a surplus over-and-above LNG requirements, what are the problems that hinder its development for the internal market in that country? Are there positive steps that can be taken to facilitate such development? The major focus of this study is therefore on the problems that arise in negotiating and implementing agreements between companies and governments. The asymmetries and differences between the behavior and perceptions of the two groups impinge on the conduct of negotiations and the nature of agreements reached between the parties. Objectives are examined for each group as well as the procedures they follow and the constraints under which they operate. The effect of differences on exploration contracts, on pricing and on fiscal regimes are examined and practical ways in which the different objectives of governments and companies can be reconciled to their mutual advantage are suggested. The report is divided into two parts. This Volume, Part One of the report, contains a synthesis of our views on the issues raised by research, and the main conclusions.

20999 **(DOE/IE/10491—T1-Vol.2) Gas in developing countries: Volume 2, Country studies.** (Oxford Institute for Energy Studies (UK)). 1987. Contract FG01-86IE10491. 207p. NTIS, PC A10/MF A01; 1; GPO Dep. Order Number DE88005799/JAW.

This volume contains detailed case-studies of the history and prospects for natural gas utilization in eight developing countries: Argentina, Egypt, Malaysia, Nigeria, Pakistan, Tanzania, Thailand and Tunisia. All of these countries have been visited by members of the research team, with the exception of Pakistan. Running through all the case-histories is the importance of defining a clear market for the gas. In some cases this can prove remarkably difficult, especially when the oil price is relatively low. In other cases a market does exist, but is very limited in relation to the size of available reserves. The other theme which recurs over and over again is the importance of the relationship between the government and its agencies, and the foreign oil companies which are involved in exploration and development of gas reserves. These two issues are addressed in detail in each case study. But it is also the case that each country highlights specific aspects of the gas story.

21000 **(GRI—8900447) 1987 GRI [Gas Research Institute] baseline projection of US energy supply and demand to 2010.** Holtberg, P.D.; Woods, T.J.; Ashby, A.B. (Gas Research Inst., Chicago, IL (USA). Strategic Analysis and Energy Forecasting Div.). Dec 1987. 80p. Gas Research Insights, Strategic Analysis and Energy Forecasting Div., 1331 Pennsylvania Ave. NW, Washington, DC 20004-1703. Order Number TI88900447/JAW.

This report summarizes the 1987 GRI Baseline Projection of US Energy Supply and Demand, which has been adopted as a major input in the planning cycle leading to the development of the Gas Research Institute (GRI) research and development program. The baseline projection presents the GRI planning outlook for the economic and energy supply and demand situation to the year 2010. The 1987 projection was prepared using the set of models that GRI has developed over several years. The results of a number of special analytical studies also became available recently. This additional information was used to modify the methodology and to enhance the detail available from the projection. This year's projection includes updated base year data, a continuing improvement of the methodology for projecting electric utility sector factors, a revised commercial sector methodology, major updates to the industrial sector model, and numerous assumption revisions. This report presents a series of summary tables, sectoral breakdowns of energy demand, and the natural gas supply and price trends. The appendices include a discussion of the methodology and assumptions used to prepare the 1987 projection with an emphasis on changes made since the 1986 baseline projection, a comparison with GRI's previous baseline projections, and a discussion of additional data used in developing the projection. 2 figs., 18 tabs.

21001 **(PB—88-160338/XAB) Industrial Utilization R and D status report: 1986-1987.** (Gas Research Inst., Chicago, IL (USA)). Sep 1987. 202p. NTIS, PC A10/MF A01.

This status report contains a summary of the projects that were underway at GRI's Industrial Utilization Research Department during May 1986 to May 1987 in six project areas; Industrial Energy Systems, Advanced Heat Transfer Systems, Burner Systems Development, Metals Industrial Processes, Nonmetals Industrial Processes, and Industrial Materials and Components. Presented are objectives and goals, accomplishments, strategy and basis for each project area, and a status review sheet for projects within the project area.

21002 **(PB—88-161005/XAB) Physical Sciences Program area: 1987 research status report. Annual summary report.** (Gas Research Inst., Chicago, IL (USA)). Jul 1987. 396p. NTIS, PC A17/MF A01.

The 1987 annual summary of the research funded and managed by GRI's Physical Sciences Department discusses the status of ongoing and planned activities in thirteen research areas grouped according to the elements of GRI's mission: Gas Supply Options (Gasification Chemistry, Geosciences, and Biological Sciences); End Use (Combustion, Heat and Mass Transfer Science, Electrochemistry, High Temperature Materials, Methane Reaction Science, and Bioengineering Sciences); Operations (Piping Materials Research and Gas Flow Research); Fundamental Sciences (Properties Research); and Exploratory Research (Exploratory Concepts). Presented are objectives and goals, accomplishments, strategy and basis for each project area, and a status review sheet for projects within the project area.

0307 Waste Management

REFER ALSO TO CITATION(S) 20979

0308 Environmental Aspects

REFER ALSO TO CITATION(S) 20997

0309 Artificial Stimulation

REFER ALSO TO CITATION(S) 20963

21003 **(DOE/MC/19404—2527-Vol.1) Measurement of dynamic reservoir conditions, Volume 1: Final report.** Boyer, C.M. II; Briscoe, F.H.; Camp, B.S.; Dobscha, F.X.; Malone, P.G.; Schwerer, F.C.; Stubbs, P.B. (USX Corp., Monroeville, PA. USS Technical Center). Dec 1986. Contract AC21-82MC19404. 126p. NTIS, PC A07/MF A01. Order Number DE88001020/JAW.

A joint venture between the US Department of Energy, the USX Corporation (formerly the United States Steel Corporation), and the Gas Research Institute was initiated to evaluate the geologic and reservoir parameters which affect the stimulation and production and coalbed methane. To accomplish this, a single-zone coalbed methane well was completed into the Mary Lee and Blue Creek coal seams in the Warrior basin of Alabama. Following the successful drilling and coring of the well, extensive reservoir testing resulted in a measured coal seam permeability of 1 millidarcy and a skin factor of -4 to +1. In-situ state-of-stress tests in the Blue Creek coal seam indicated a vertical primary closure and a secondary horizontal closure. Coal and rock core samples were collected from the well and evaluated for flow and mechanical properties. These tests resulted in reservoir and mechanical values consistent with well-test data and underground fracture observation. Geologic studies established the geometry of the target reservoir and the surrounding strata. Unstimulated production tests were performed to establish baseline production parameters for both the Mary Lee and Blue Creek coal seams. Utilizing the collected data from the various test programs, a state-of-the-art hydraulic stimulation was designed and implemented. Detailed monitoring of selective variables during the stimulation permitted an initial evaluation of the success of the stimulation. Following stimulation, production testing evaluated the impact of the hydraulic stimulation on gas and water production. Underground observation of the induced hydraulic fracture revealed fracture containment in the target coal seam with a vertical and horizontal component. Utilizing a fracture-simulation model and the stimulation-pressure record, a combined vertical and horizontal fracture was created that closely matched the observed in-situ fracture. 18 refs., 47 figs., 10 tabs.

21004 **(DOE/MC/19404—2527-Vol.2) Measurement of dynamic reservoir conditions, Volume 2: Final report.** Boyer, C.M. II; Briscoe, F.H.; Camp, B.S.; Dobscha, F.X.; Malone, P.G.; Schwerer, F.C.; Stubbs, P.B. (USX Corp., Monroeville, PA. USS Technical Center). Dec 1986. Contract AC21-82MC19404. 794p. NTIS, PC A99. Order Number DE88006281/JAW.

US Steel's Southern Appalachian Field Office conducted a study to determine if a relationship existed between structure and coal seam gas production. The study consisted of mapping surface joints, tracing linears, and evaluating gas and water production from US Steel's Oak Grove Coal Degasification Field. Gas production within the Oak Grove Field shows "high" production in the east and central portions of the field. Production outside the "high" gas producing zones appears to be a function of original gas content and/or in-place methane content. Production within the "high" zones appears to be related to a set of east-west trending joints associated with the eastern boundary fault of Oak Grove Mine. These joints are believed to increase production by increasing gas contributions from adjacent seams and/or increasing the permeability of the coal seam. If all other factors (depth, gas content, and coal thickness) are approximately equal, substantial increases in gas production can likely be achieved by locating coal degasification wells in areas of dense jointing associated with normal faults.

21005 **(PB—88-159074/XAB) Analysis of benefits for research and development projects for unconventional gas resources proposed by the Gas Research Institute. Topical report.** (TRW Energy Systems Group, Redondo Beach, CA (USA)). Mar 1978. 117p. NTIS, PC A06/MF A01.

See also PB—88-159082.

This report presents a benefits analysis of GRI's proposed research and development (R&D) projects involving the following unconventional gas resources: western gas sands, eastern gas shales, methane from coal deposits, geopressured zones and saltwater aquifers, and methane hydrates. The ongoing DOE/industry projects plus the proposed GRI R&D projects represent a total R&D cost from 1979 through 1983 of $632 million, of which $148.4 million is the GRI portion. The study addresses the following issues: resource characterization and estimation, current technology and R&D activities, cost of ongoing and planned activities, estimated cost of gas production, expected gas production due to improved technology resulting from R&D activities, user benefits in terms of lower cost of gas relative to alternative energy sources, and other benefits such as improved coal-mine working conditions and production of geothermal energy in conjunction with gas production from geopressured aquifers.

21006 **(PB—88-159082/XAB) Analysis of benefits for research and development projects for unconventional gas resources proposed by the Gas Research Institute: Executive Summary. Topical report.** (TRW Energy Systems Group, Redondo Beach, CA (USA)). Mar 1978. 23p. NTIS, PC A03/MF A01.

See also PB—88-159074.

This Executive Summary presents the results of a benefits analysis of GRI's proposed research and development (R&D) projects involving the following unconventional gas resources: western gas sands, eastern gas shales, methane for coal deposits, geopressured zones and saltwater aquifers, and methane hydrates. The total R&D cost of ongoing DOE/industry projects plus the proposed GRI R&D projects from 1979 through 1983 is $632 million, of which GRI's portion is $148.4 million. The study addresses the following issues: resource characterization and estimation, current technology and R&D activities, cost of ongoing and planned activities, estimated cost of gas production, expected gas production due to improved technology resulting from R&D activities, user benefits in terms of lower cost of gas relative to alternative energy sources, and other benefits such as improved coal mine working conditions and production of geothermal energy in conjunction with gas production from geopressured aquifers.

21007 **(PB—88-160908/XAB) Rock Creek methane from multiple-coal-seams completion project - demonstrated drilling and completion technology for the multiple-seams completion project. Topical report, March 1983-December 1986.** Boyer, C.M.; Briscoe, F.H.; Camp, B.S.; Dobscha, F.X.; Malone, P.G. (USX Corp., Monroeville, PA. USS Technical Center). Dec 1986. 191p. NTIS, PC A09/MF A01.

Commercialization of coalbed methane, especially in the eastern United States, has been primarily limited to gas production from a single coal seam per well. The Multi-Seam Project is a multi-year joint venture investigating the combination of drilling, completion, stimulation, and production parameters required for the viable economic production of methane from shallow, multiple coal seams. The initial drilling and completion at the project site was limited to single-zone completions. Details of the drilling, casing, and cementing are presented, which include a novel technique for isolation and non-contamination of zones using a staged-cementing procedure.

0310 Legislation And Regulation

REFER ALSO TO CITATION(S) 20998, 20999

0320 Transport, Pipelines, And Handling

21008 **(PB—88-157367/XAB) Design procedure and test method to prevent rapid crack propagation in polyethylene gas pipe. Topical report, January 1979-April 1986.** Krishnaswamy, P.; Maxey, W.; Leis, B.; Hulbert, L. (Battelle Columbus Div., OH (USA)). Oct 1986. 127p. NTIS, PC A07/MF A01.

Rapid crack propagation (RCP) is a phenomenon involving a running axial crack that may travel long distances at high speeds in a pressurized pipeline. It has been observed in large-diameter steel gas-transmission pipelines. The report describes the results of extensive full-scale field tests and modified Robertson tests that were run on 11 lots of PE2306 and PE3408 pipes to study RCP in polyethylene pipes.

0330 Properties

REFER ALSO TO CITATION(S) 21180

21009 **(PB—88-136379/XAB) Application of the new classification parameters to Northern and Southern Hemisphere coals.** Kruszewska, K. (National Inst. for Coal Research, Pretoria (South Africa)). 1986. 17p. (COAL—8603). NTIS, PC E04/MF E04.

North American Continent sales only.

This report concludes the following. (1) Reflectance is a good rank parameter which may be applied for bituminous coals and anthracites. For lower-rank coals the random reflectance is applicable; For coals of higher rank maximum reflectance is applied, supported by bireflectance if necessary. (2) Modern international classifications should take into account two fundamental types of humic coals: vitrinitic and intertinitic. However, these types should be very precisely and unambiguously defined. (3) Inertinite content as a type parameter is inadequate for inertinite rich coals.

21010 **Theory and measurement of hydrate dissociation.** Ullerich, J.W.; Selim, M.S.; Sloan, E.D. (Dept. of Chemical Engineering, and Petroleum Refining, Colorado School of Mines, Golden, CO 80401). *A.I.Ch.E. Journal (New York);* **33**: No. 5, 747-752(May 1987).

Experimental data on the rate of dissociation of methane hydrates are presented. The data were obtained from hydrate mass loss measurements using an electrobalance. A resistance heater with a known heat flux was used in the dissociation experiments. A mathematical model describing the dissociation process is also presented. The model, based upon first principles, assumes that the water formed during dissociation is blown away by the methane gas produced so that the dissociation process may be regarded as a moving-boundary ablation problem. Agreement between the model and the data is within 10%.

0340 Combustion

REFER ALSO TO CITATION(S) 21902

21011 **(AD-A—187219/1/XAB) Particulate flow dynamics and erosion in gas turbines.** Hamed, A.; Tabakoff, W. (Cincinnati Univ., OH (USA). Dept. of Aerospace Engineering and Engineering Mechanics). Sep 1987. 10p. NTIS, PC A02/MF A01.

Pub. in Proceedings of the Internation Conference on Erosion by Liquid and Solid Impact (7th), 77-1-77-8(7-10 Sep 1987).

Results of a detailed study of the effect of particle characteristics on the particle dynamics and on the resulting pattern of particle blade impacts and the blade erosion in a two-stage axial-flow gas turbine operating with particle-laden flows are presented. The particle dynamics computations simulate particle/gas interactions and particle/blade interactions as determined from the experimental rebound characteristics The results show the fly ash and sand particles impact patterns in all stationary and rotating-blade rows. The corresponding turbine-blade erosion is predicted using the impact data and empirical correlations from erosion experimental measurements for fly-ash particles. The results indicate that the particle/blade impact locations and frequency, and consequently the associated pattern and intensity of blade erosion, are dependent on blade-row location and particle characteristics. They also indicate that the first rotor is subjected to maximum erosion.

21012 **(PB—88-124888/XAB) Reliability evaluation system for ceramic gas turbines.** Hamanaka, J.; Hashimoto, Y.; Ohkoshi, A.; Watanabe, N. (Ishikawajima-Harima Heavy Industries Co. Ltd., Tokyo (Japan)). 1987. 7p. NTIS, PC E04/MF A01.

Included in IHI (Ishikawajima-Harima Heavy Industries) Engineering Review, Vol. 20, No. 3, 83-88(Jul 1987).

A reliability-evaluation system for ceramic gas turbines was developed by IHI. The system is based on results of the finite-element stress analysis with a probabilistic analysis of ceramic structures. In the system, a new probabilistic method was used to estimate time and cycles to failure of multiaxially stressed ceramic structures. Using the system fast fracture, static fatigue and dynamic fatigue can be evaluated. Also, the effect of the proof test on these failure modes can be evaluated quantitatively. This reliability evaluation is performed by using the stress analysis of the general purpose program NASTRAN. The necessary data base for the above evaluation is constructed by the preprocessor of the system based on the calculation results of NASTRAN and user's input data. Evaluation results are shown on the graphic display and the plotter.

21013 **(PB—88-157383/XAB) Gas-fired radiant tubes: a review of literature. Topical report.** Harder, R.F.; Viskanta, R.; Ramadhyani, S. (Purdue Univ., Lafayette, IN (USA). School of Mechanical Engineering). Dec 1987. 88p. NTIS, PC A05/MF A01.

A critical review of the literature on gas-fired radiant tubes was performed. The review focused on experimental work which has been reported in the published literature. The work on straight-through, U-type, W-type, and blind-ended radiant tubes is discussed. The advantages and disadvantages of these and other innovative radiant tube designs are described and summarized. The review has revealed that significant technological developments on radiant tubes have taken place during the last 50 years as reported in the English, French, German, Japanese and Russian literature. Very little work appears to have been done in the United States, because it has not been reported in the open literature owing to proprietary considerations.

21014 **(PB—88-160916/XAB) Test methodology for infrared tubular heaters. Topical report, June 1984-September 1985.** Huang, V.M.S.; Zawacki, T.S. (Institute of Gas Technology, Chicago, IL (USA)). Dec 1987. 79p. NTIS, PC A05/MF A01.

The current ANSI standard (Z83.6-1982) for determination of the total infrared heat output of commercial space heaters is not broad enough to encompass all of the equipment currently in the

marketplace. For example, long straight or U-shaped tubular heaters cannot be evaluated under the spherical grid specified by the standard. The grid size is simply too large for practical use. To extend the procedure to others heaters, a literature survey and a laboratory evaluation were performed. Current test procedures and equipment used to measure infrared heat rates were evaluated. A procedure was developed to measure total radiant output based on the use of a 180-degree view angle radiometer and a cylindrical grid surrounding the heater. The procedure was tested in the laboratory and found to perform satisfactorily. A total radiant output of 40,500 Btu/h emanating from a straight-tube heater operating at 104,000 Btu/h was measured. In order to proceed to develop a measurement standard, several parameters must be carefully assessed and defined: radiometer window material, need for radiometer water cooling, calibration techniques, and background measurements.

04 OIL SHALES AND TAR SANDS

0402 Site Geology And Hydrology

REFER ALSO TO CITATION(S) 21025

0404 Oil Production, Recovery, And Refining

REFER ALSO TO CITATION(S) 20966, 21022, 21022, 21023, 21023, 21025

21015 **(DOE/ET/14363—T18-Vol.1) Beneficiation of oil shales by froth flotation and heavy media separation: Volume 1, Summary and main report: Final report.** Krishnan, G.N. (SRI International, Menlo Park, CA (USA)). Aug 1987. Contract AC01-80ET14363. 61p. NTIS, PC A04/MF A01; GPO Dep. Order Number DE88004679/JAW.

An experimental program was conducted to determine the feasibility of upgrading US oil shales by froth flotation and heavy media separation (HMS) techniques. The results of the experiments along with other available information were used to analyze technical and economic aspects of a process scheme in which a mined shale will be beneficiated and then retorted. The experimental program and economic analysis indicate that whereas beneficiation processes do not offer any clear incentive at the current time, these processes may become essential when lean deposits are to be exploited. Froth flotation process appears to be significantly superior than the HMS process. The significant deterrents to developing a beneficiation process based on froth flotation are grinding costs and lack of suitable retorts. 15 refs., 13 figs., 13 tabs.

21016 **(DOE/MC/60177—2447) Design and shakedown of an inclined liquid fluid-bed reactor system.** Johnson, L.A. Jr.; Cha, Chang Yul. (Western Research Inst., Laramie, WY (USA)). Sep 1987. Contract FC21-83FE60177. 13p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88005669/JAW.

This report describes the design and shakedown testing of an inclined liquid fluid-bed reactor system. The system is being developed for processing tar sand with a recycle oil pyrolysis and extraction process to produce a high yield of specialty products. Also reported are the results of cold-flow model tests, which were used to assist in the design of the reactor system. Shakedown tests showed the potential of the process to recover the majority of the bitumen from Asphalt Ridge tar sand and also provided data for the future modifications to improve the reactor performance. Recommendations based on shakedown test results are made for improvements in the tar sand feed, product collection, and disparger components of the reactor system to permit better reactor control and operation. 2 refs., 4 figs.

21017 **(UCID—16986-87-4) Lawrence Livermore National Laboratory oil shale: Quarterly report, October-December 1987.** Lewis, A.E. (ed.). (Lawrence Livermore National Lab., CA (USA)). Jan 1988. Contract W-7405-ENG-48. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88006777/JAW.

A unique mass spectrometry (MS) method for the study of water formation during oil shale batch pyrolysis was recently discussed. Water evolution observations differ from what others have reported, necessitating a detailed quality assurance study. That study is discussed in this report, along with the water calibration techniques that have been used to obtain quantitative data from our Triple Quadrupole Mass Spectrometer (TQMS) - which normally provides qualitative information. The rate of pyrolysis of raw shale and the rate of combustion of retorted shale in a new apparatus which allows C and H mass balances have been measured. Thus, the fraction of the raw shale organic C that is pyrolyzed and burned can be measured. The shale sample is fluidized with an inert gas which sweeps the pyrolysis gases out of the pyrolyzer and into a tube furnace where they are burned with oxygen. The concentrations of carbon dioxide and steam produced by this oxidation are measured on-line by means of a mass spectrometer. Following pyrolysis, the organic C and H which remain in the retorted shale are burned in the same fluidized bed by adding oxygen to the fluidizing gas. An experiment has also been conducted to find out if indeed Green River shale can be retorted in half the time generally used. The LLNL pilot retort was used, and the pyrolysis appears to have been completed when pyrolysis time at 500^0 was reduced from 3 m to 1.5 m. The evidence is the fact that the combustor temperature, which is sensitive to the carbon content of the retorted shale, did not increase when pyrolysis time was reduced.

21018 **(DOE/ET/14363—T18-Vol.3-App.B) Beneficiation of oil shales by froth flotation and heavy media separation: Volume 3, Appendix B: Final report.** Veselick, E.; West, J. (eds.). (Fuel and Mineral Resources, Inc., Reston, VA (USA)). Aug 1987. Contract AC01-80ET14363. 114p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88004681/JAW.

A study to evaluate physical beneficiation processes was undertaken to assess the efficiency of beneficiating oil shale, and to measure its impact on the economics of shale oil production. This study evaluated the effect of crusher types and degree of crushing on beneficiation of oil shales, the natural beneficiation that occurs due to particle size distribution, different beneficiation techniques (heavy liquid sink-float, heavy media cyclones, and froth flotation), and the costs associated with beneficiating low grade oil shales. Every effort was made to incorporate all test available in published reports for both the Green River and Eastern Oil Shales. Results of beneficiation tests show that within the scatter in data, there is no effect of shale particle size (between 45 microns to -3"), method of beneficiation, grade of feed material (13 to 3/GPT), or type of crusher used on oil recovery. The geochemical nature of the oil shale clearly shows that maximum separation of kerogen and inorganic materials occur at particle size below 20 microns. This was verified when the froth flotation technique was used on these fine particle sizes; the oil recovery increased dramatically with much lower oil losses. Analysis of the data shows that froth flotation is the preferred technique for beneficiating oil shales as opposed to heavy media separation. 17 refs., 31 figs., 42 tabs.

21019 **(DOE/ET/14363—T18-Vol.2-App.A) Beneficiation of oil shales by froth flotation and heavy media separation: Volume 2, Appendix A: Final Report.** (Minerals Separation Corp., Tucson, AZ (USA)). Aug 1987. Contract AC01-80ET14363. 81p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88004680/JAW.

As a review, the hypothesis being tested in this program was that crushing to finer crush sizes liberates more high grade oil shale thereby allowing for increased oil recovery at higher grades. Heavy medium technology utilizing dynamic vessels can successfully upgrade properly sized oil shale. It should be stressed that the shale must be well screened to remove -28 mesh material to allow for successful plant operation. The fines if not removed an result in significant operating problems by increasing the viscosity of the medium being used. As a review, the medium mixes used for this study would suggest that, at necessary gravities of separation, a mixture between magnetite and ferrosilicon will be necessary in an operating plant. The pilot plant results suggest that some small advantage does exist in the grade recovery relationship as a function of top crush size. As the crust size decreases, a higher grade product can be recovered. For the 3/4" and 3/8" crust size, however, this product will not be better than 0.5 to 1.0 gallon per ton higher in grade as the crush size is decreased from 3/4" to 3/8". Judging

only on the heavy liquid results, here appears to be no great advantage to crushing beyond 3" for upgrading by heavy medium techniques. The true economic balance will be between final grade produced and the economics of retorting and handling of the tailings material. From the work presented herein it would appear as if no more than a two gallon per ton advantage will be achieved in the final product by crushing from say 1-1/2" to 3/8". It is apparent that within the +28 mesh fraction, higher grade samples at internally higher recoveries can be achieved; however, when compared to the total oil feeding the plant, i.e., total ore, these recovery grade improvements are diminished. 11 figs., 16 tabs.

0405 Properties And Composition

REFER ALSO TO CITATION(S) 21024, 23358

21020 **(DOE/FE/60177—2452) An NMR [nuclear magnetic resonance] investigation of the chemical association and molecular dynamics in asphalt ridge tar sand ore and bitumen.** Netzel, D.A.; Coover, P.T. (Western Research Inst., Laramie, WY (USA)). Sep 1987. Contract FC21-83FE60177. 21p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88006578/JAW.

Preliminary studies on tar sand bitumen given in this report have shown that the reassociation of tar sand bitumen to its original molecular configuration after thermal stressing is a first-order process requiring nearly a week to establish equilibrium. Studies were also conducted on the dissolution of tar sand bitumen in solvents of varying polarity. At a high-weight fraction of solute to solvent the apparent molecular weight of the bitumen molecules was greater than that of the original bitumen when dissolved in chloroform-d_1 and benzene-d_6. This increase in the apparent molecular weight may be due to micellar formation or a weak solute-solvent molecular complex. Upon further dilution with any of the solvents studied, the apparent molecular weight of the tar sand bitumen decreased because of reduced van der Waals forces of interaction and/or hydrogen bonding. To define the exact nature of the interactions, it will be necessary to have viscosity measurements of the solutions. 30 refs., 3 figs., 3 tabs.

21021 **(DOE/MC/11076—2448) Characterization of DOE reference oil shales: Mahogany Zone, Parachute Creek Member, Green River Formation Oil Shale, and Clegg Creek Member, New Albany Shale.** Miknis, F.P.; Robertson, R.E. (Western Research Inst., Laramie, WY (USA)). Sep 1987. Contract FC21-86MC11076. 99p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88005703/JAW.

Measurements have been made on the chemical and physical properties of two oil shales designated as reference oil shales by the Department of Energy. One oil shale is a Green River Formation, Parachute Creek Member, Mahogany Zone Colorado oil shale from the Exxon Colony mine and the other is a Clegg Creek Member, New Albany shale from Kentucky. Material balance Fischer assays, carbon aromaticities, thermal properties, and bulk mineralogic properties have been determined for the oil shales. Kerogen concentrates were prepared from both shales. The measured properties of the reference shales are comparable to results obtained from previous studies on similar shales. The western reference shale has a low carbon aromaticity, high Fischer assay conversion to oil, and a dominant carbonate mineralogy. The eastern reference shale has a high carbon aromaticity, low Fischer assay conversion to oil, and a dominant silicate mineralogy. Chemical and physical properties, including ASTM distillations, have been determined for shale oils produced from the reference shales. The distillation data were used in conjunction with API correlations to calculate a large number of shale oil properties that are required for computer models such as ASPEN. There was poor agreement between measured and calculated molecular weights for the total shale oil produced from each shale. However, measured and calculated molecular weights agreed reasonably well for true boiling point distillate fractions in the temperature range of 204 to 399°C (400 to 750°F). Similarly, measured and calculated viscosities of the total shale oils were in disagreement, whereas good agreement was obtained on distillate fractions for a boiling range up to 315°C (600°F). Thermal and dielectric properties were determined for the shales and shale oils. The dielectric properties of the reference shales and shale oils decreased with increasing frequency of the applied frequency. 42 refs., 34 figs., 24 tabs.

21022 **(DOE/MC/11076—2451) Potential end uses of oil produced by wet forward combustion of Asphalt Ridge tar sand.** Thomas, K.P.; Harnsberger, P.M.; Guffey, F.D. (Western Research Inst., Laramie, WY (USA)). Sep 1987. Contract FC21-86MC11076. 16p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006196/JAW.

In this report an evaluation is made of the potential end uses of an oil produced from Asphalt Ridge tar sand by wet forward combustion. The oil is evaluated with respect to its potential to produce a specification-grade asphalt and an aviation turbine fuel. To accomplish this the oil was vacuum distilled to produce a distillate and a residue. The distillation residue meets all of the ASTM D-3381 Table 1 specification tests for an AC-10 asphalt. However, the 135°C (275°F) viscosity is low when compared with the more stringent ASTM D-3381 Table 2 requirements. The residue also has an unusually low aging index. This indicates not only that it may not set properly, but also it may be resistant to rapid age hardening. The results from successive freeze-thaw cycling indicate that the residue, when coated on appropriate aggregates, is comparable to or better than some petroleum asphalts coated on the same aggregates. Freeze-thaw cycling to failure is an indirect measure of the resistance of an asphalt-aggregate mixture to moisture-induced loss of strength. The distillate of the thermally produced oil represents about 50 wt % of the oil. The chemical and physical properties of the distillate are better than those of the original bitumen and the thermally produced oil. Combined gas chromatographic/mass spectral analysis of the neutral fraction from the distillate indicates it is composed of predominantly aromatic structures. The aromatic structures are primarily of the 2- and 3-ring type and the saturate structures are primarily of the 3-ring type. It is believed that upon hydrogenation this distillate could be a source of high-density or endothermic aviation turbine fuels.

21023 **(UCID—16986-87-2) Lawrence Livermore National Laboratory Oil Shale Project: Quarterly report, April-June 1987.** Lewis, A.E. (ed.). (Lawrence Livermore National Lab., CA (USA)). Aug 1987. Contract W-7405-ENG-48. 15p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005101/JAW.

In the past the disposition of sulfur into the various product streams of our recycle retort has been investigated. During this reporting period the sulfur speciation in these solid streams as a guide to spent-shale disposal has been measured. A study of gas evolution during oil shale pyrolysis is discussed and the fluidized bed retort has been utilized for the investigation of a free radical steady state involving equilibration of intermediates.

0406 Direct Uses And By-products

REFER ALSO TO CITATION(S) 21947

0407 Health And Safety

REFER ALSO TO CITATION(S) 21025

0408 Marketing And Economics

REFER ALSO TO CITATION(S) 21015, 21018, 21019

0409 Waste Research And Management

REFER ALSO TO CITATION(S) 21025

21024 **(DOE/MC/11076—2446) Investigation of sorption interactions between organic and mineral phases of processed oil shale.** Blanche, M.S.; Bowen, J.M. (Western Research Inst., Laramie, WY (USA)). Nov 1987. Contract FC21-86MC11076. 34p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005668/JAW.

Minerals and organic compounds representative of oil shale processing wastes were analyzed for potential sorption interactions. The analysis consisted of Fourier Transform Infrared spectroscopy, high performance liquid chromatography, thermogravimetric and differential scanning calorimetry, and laser Raman spectroscopy. Montmorillonite clay was used as a representative of the smectites found in raw and spent shales, and hematite was used as a representative of iron oxide found in spent shales. Benzene, 2,2,4-trimethylpentane, benzoic acid, sodium benzoate, and pyridine were used as representatives of oil shale process organic wastes. In addition, isopropylamine and dimethyl methylphosphonate, a pesticide model, were studied. A preparation methods comparison study was performed and established the validity of the solid state KBr sample preparation technique upon FTIR spectral quality. The results of this study illustrate the utility of fourier transform infrared spectroscopic analysis to establish and describe the potential for sorption interactions between inorganic and organic phases of oil shale processing wastes. Experimentation with the laser remain system shows promise for significant contributions in this field of research. 43 refs., 3 figs., 6 tabs.

0410 Environmental Aspects

21025 **(DOE/FE/60177—2445) Plan for addressing issues relating to oil shale plant siting.** Noridin, J.S.; Donovan, R.; Trudell, L.; Dean, J.; Blevins, A.; Harrington, L.W.; James, R.; Berdan, G. (Western Research Inst., Laramie, WY (USA)). Sep 1987. Contract FC21-83FE60177. 359p. NTIS, PC A16/MF A01; 1; GPO Dep. Order Number DE88005119/JAW.

The Western Research Institute plan for addressing oil shale plant siting methodology calls for identifying the available resources such as oil shale, water, topography and transportation, and human resources. Restrictions on development are addressed: land ownership, land use, water rights, environment, socioeconomics, culture, health and safety, and other institutional restrictions. Descriptions of the technologies for development of oil shale resources are included. The impacts of oil shale development on the environment, socioeconomic structure, water availability, and other conditions are discussed. Finally, the Western Research Institute plan proposes to integrate these topics to develop a flow chart for oil shale plant siting. Western Research Institute has (1) identified relative topics for shale oil plant siting, (2) surveyed both published and unpublished information, and (3) identified data gaps and research needs. 910 refs., 3 figs., 30 tabs.

0420 Regulations

REFER ALSO TO CITATION(S) 21025

05 NUCLEAR FUELS

REFER ALSO TO CITATION(S) 23951

21026 **(INIS-XN—120) Electricity, nuclear power and fuel cycle in OECD countries, main data 1987.** (Nuclear Energy Agency, 75 - Paris (France)). 1987. 33p. (In French and English). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701102/JAW.

A questionnaire on Electricity Generation. Nuclear Power and Fuel Cycle Data is distributed annually to OECD Member Countries. In the questionnaire of January 1987, countries were asked to provide historical data for 1985 and 1986 and most likely projections up to the year 2005. The replies to the questionnaire or the results of the discussions between national correspondents and the Secretariat are presented in this Booklet. The Secretariat has, in some cases, referred to IEA's electricity-related data and IAEA's nuclear plant data. Where data were still unavailable the Secretariat made estimates based on information from other sources. Data for 1986 are provisional for several countries. The data on electricity generation and electric capacity are presented to the year 2005, and the data on fuel cycle services to the year 2000. The installed nuclear capacity of the OECD countries for the year 2000 is estimated at 340 GWe, a 25 GWe reduction from the estimate in the 1986 Booklet. This reduction is mainly due to revised lower projections of electricity demand. The Addendum contains an analysis of the present and past projections for installed nuclear capacity to 2000. It shows the total capacity of those plants connected to the grid, under construction and firmly planned to be in operation in 2000 as 294 GWe. The new projection of 340 GWe is well above this estimate, indicating that some countries are still planning to expand their nuclear capacities. In only one country does it appear that planned expansion has been affected specifically by the Chernobyl accident. The electricity generation and production data for fuel cycle services refer to those facilities located within the country, and thus exclude imports. The fuel cycle requirements, however, refer to the amounts of fuel cycle materials and services necessary for national nuclear power programmes.

0501 Reserves, Exploration, And Mining

21027 **(IAE—4295/13) Contents of uranium, thorium and accessory elements (Pb, As, Hg, Bi, Rb, Sr) in rocks and mineral sediments of acting hydrothermal system of the Uzon caldera in Kamchatka.** Adamchuk, Yu.V.; Karpov, G.A.; Maksimovskij, V.A.; Petrova, N.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1986. 34p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701025/JAW.

Sampling of the modern hydrothermal system of the Uzon caldera was carried out both over the area and in depth (up to 50 m) to reveal distribution regularities in hydrothermally alterated rocks of uranium, thorium and a number of accessary elements characteristic of the Kamchatka region. Increased (as compared with background) content of radioactive elements for some areas of alterated rocks and anomalously high uranium concentration in fresh mineral deposits have been detected. At that uranium and thorium accumulation occurs syngenetically with rock argillization of montmorillonite series, mainly, and their localization is controlled with tectonic dislocations and geochemical barriers. Mean value of thorium-uranium ratio in the alterated rocks of the Uzon thermal fields equals ~ 3.5, and mean values of uranium and thorium concentrations equal 1.9 and 3.7 g/t, accordingly. Strong positive correlation is noted for pairs U-Th, U-Rb, Th-Pb, Th-Bi, Th-As, Rb-Sr and Pb-As; the absence of correlation for Th-Rb, U-As, Th-Sr and trend to negative correlation is noted in U-Sr pair. 46 refs.; 6 figs.; 6 tabs.

21028 **(MINTEK-M—278) Uranium-thorium silicates, with specific reference to the species in the Witwatersrand reefs.** Smits, G. (Council for Mineral Technology, Randburg (South Africa)). 15 Jan 1987. 37p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88900362/JAW.

(U,Th)-silicates form two complete series of anhydrous and hydrated species with general formulae $(U,Th)SiO_4$ and $(U,Th)SiO_4.nH_2O$ respectively. The end-members of the anhydrous series are anhydrous coffinite and thorite, and those of the hydrated series, coffinite and thorogummite. Although the silicates are relatively rare in nature, coffinite is a common ore mineral in uranium deposits of the sandstone type. In the Witwatersrand reefs, (U,Th)-silicates are extremely rare in most reefs, except for the Elsburg Reefs on the West Rand Goldfield and the Dominion Reef. In these reefs detrital uraninite has been partly or entirely transformed to (U,Th)-silicates of coffinite composition, but thorite and thorogummite of detrital origin are also found in the Dominion Reef. In leaching tests on polished sections of rock samples containing (U,Th)-silicates, a dilute sulphuric acid solution, to which ferric iron had been added, was used as the lixiviant. It appeared that the dissolution of coffinite is less rapid than that of uraninite and uraniferous leucoxene. However, the reaction of silicates of high thorium content is much slower, and was not completed during the tests.

21029 **(NEI-DK—70) Development and testing of a model for the supergene distribution of uranium and accompanying elements around a known uranium deposit associated with an alkaline intrusion.** (Copenhagen Univ. (Denmark). Inst. for Petrology). 1983. 185p. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88752055/JAW.

This report deals with secondary geochemical dispersion in a subarct environment (Ilimaussaq Complex, south Greenland) of uranium and accompanying elements around a U deposit in which the refractory mineral steenstrupine is the main U-bearing mineral. Weathering profiles, including soils, and sediments in rivers, lakes and fjords have been sampled and studied. Chemical weathering is not well developed. The coarse-grained agpaitic nepheline syenites of the Ilimaussaq Complex are covered by debris of crumbling material and practically without vegetation, but soil profiles and vegetation are developed on glacial deposits and on weathered basement granite. 480 samples have been analysed for 22 elements and the data treated by multivariable analyses with main emphasis on principal component analysis. It was found that U and the other elements have been dispersed during weathering. The sediments in rivers and fjords show low correlation of U with those elements that are associated with U Ilimaussaq. Principal component analysis of the total sample materia of soils and lake and river sediments based on 17 elements makes the identification of the area containing the U deposit possible in the first three dimentions. The elements used are those which correlate with Th in this type of deposit. The statistical significance is however low when singlesample populations, as for instance the C-horizons of soils, are used. 41 refs. (EG).

21030 **(NEI-DK—71) Geology and evaluation of the uranium mineral occurrence at Igdlorssuit, South Greenland. Report no. 2, The South Greenland exploration programme 1984-1986.** Armour-Brown, A. (Groenlands Geologiske Undersoegelse, Copenhagen (Denmark)). May 1986. 60p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88752056/JAW.

EFP-84.

Geological and radiometric mapping, and petrological and mineralogical investigations were made of a uranium mineral occurence at Igdlorssuit, South Greenland during 1984 and 1985. The results have been evaluated in terms of the uranium potential and genesis the showing. The work was part of the South Greenland Exploration Programme (Sydex) carried out by the Geological Survey of Greenland (GGU) in cooperation with Risoe National Laboratory (Risoe). It was financed by the Danish Ministry of Energy. Igdlorssuit is located at the northerly limit of the fjord system about 60 km north of Kap Farvel (60 deg. 23 min.; 46 deg. 06 min.). The main uranium mineral showing is on a small alp on the eastern side, 500 m vertically above the fjord. Detailed plane table mapping (1:1000), and radiometric measurements with a lead collimated scintillometer calibrated for uranium delineated this occurence: Regional mapping (1:10 000), however, showed that it was only one of many similar uranium occurences in the area albeit the largest and richest. Over 35 uranium mineral occurences have been found scattered over the hillside. Textural and paragenetic relationships, and isotopic data show that the uranium was present in the supracrustal units before the folding, metamorphism and intrusion of the granite. The largest, highest grade uranium mineralised zone is about 50m long and up to 5m wide with an average grade of 0.31% with highs up to 7%. The results of the mapping and sampling has established that this type of mineral occurence can reach economic grades, and its surface expression suggests a size which could approach economic proportions. 3 maps, 30 refs. (EG).

21031 **(NEI-DK—72) Uranium occurrences in the Granite Zone. Structural setting-genesis-exploration methods. Report no. 1, The South Greenland exploration programme 1984-1986.** Nyegaard, P.; Armour-Brown, A. (Groenlands Geologiske Undersoegelse, Copenhagen (Denmark)). Apr 1986. 138p. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88752057/JAW.

EFP-84.

This report describes the work and results of the South Greenland Exploration Programme (Sydex) during the 1984 field season in the Granite Zone, and discusses the results and conclusions that can be drawn from them. It also contains a structural analysis of the Ivigtut-Julianehaab region, which will help in future exploration by indicating the likely directions of uraniferous faults and fractures. It also includes suggestions for future work with both exploration and scientific aspects. The project was carried out by the Geological Survey Greenland (GGU) in co-operation with Risoe National Laboratory. It was financed by the Danish Ministry of Energy. The structural analysis was carried out using previous geological maps, our own field observations and an analysis of lineament frequencies taken from aerial photographs and satellite images. Major lineaments in the region are due to E-W sinistral wrench faults and NE-SW normal faults. Analysis of the minor lineaments showed that the region could be divided into three blocks which have each reacted differently to the same regional stress field which was active throughout the Gardar period. A northern block which has been influenced by an older system of faults in the Archaean gneiss, a central block dominated by a graben, and a southern block where there is a change to a less intensively faulted area. 2 maps, 27 refs. (EG).

0504 Feed Processing

21032 **(INIS-BR—961) Flotation in column-recovery of fine uranium phosphate ore from Itataia, in Brazil.** Reis Junior, J.B.; Peres, A.E.C. (Centro de Desenvolvimento da Tecnologia Nuclear, Belo Horizonte (Brazil); Minas Gerais Univ., Belo Horizonte (Brazil). Escola de Engenharia). (Centro de Desenvolvimento da Tecnologia Nuclear, Belo Horizonte (Brazil)). [1987]. 17p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701615/JAW.

A systematic study of main variables of the flotation column and, the study of different pillot circuits integrated by flotation cells in colunm and mechanic cells, aiming at reduction the loss of the sludges for processing uranium phosphate from Itataia, in Brazil, are presented. A recovery of 49% of P/sub 2/O/sub 5/ for a content of 24% of P/sub 2/O/sub 5/ and 0,185% of U/sub 3/O/sub 8/ in the concentrate, using a circuit with two columns, a rougher and scavenger, was obtained. For a content of 33.4% of P/sub 2/O/sub 5/ and 0.240% of U/sub 3/O/sub 8/, a recovery of 38% of P/sub 2/O/sub 5/ was obtained, using a circuit composed by a mechanical cell as scavenger and two columns as rougher and cleaner. The circuit used to obtain these parameters operated with 7,6 Kg/h solid flow in the grain size range of 10μm and 3μm and the flotation column with 5 cm of diameter and 6m of high. (M.C.K.).

21033 **(NUCLEBRAS-CDTN—519) Th O/sub 2/ and (Th, U) O/sub 2/ dissolution in solution of nitric acid and hydrofluoric acid.** Lopes, M.J.O.; Filgueiras, S.A.C. (Centro de Desenvolvimento da Tecnologia Nuclear, Belo Horizonte (Brazil)). 1985. 14p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701694/JAW.

The main parameters in the dissolution of the nuclear fuel are analysed. Th O/sub 2/ and (Th, 5%U)O/sub 2/ are used as experimental materials and its dissolution behaviour are examined. (C.B.).

0505 Uranium Enrichment

21034 **(K/CSD/TM—71) AVRAM user's manual.** McGrady, P.W. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). Feb 1988. Contract AC05-84OT21400. 46p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88006727/JAW.

This document details the use of the reliability code for the Atomic Vapor Laser Isotope Separation (AVLIS) project. This code was designed by Tom Anklam and John Harris. In late 1984 Patrick McGrady and Elena Koontz of C & TD/TA were assigned the task of improving the code and converting it for use on the DEC-10 system. In early 1986, Patric McGrady converted it to the CRAY. The AVRAM code is divided into distinct parts (often referred to as programs in this document). There is a COSMOS file that controls the execution of the FORTRAN code and controls the naming of output datasets and the deletion of temporary datasets created by the code. The FORTRAN code consists of a main program as a driver and of three main subroutines: EDIT,

PARAM, and AVRAM. The EDIT program allows the user to create a new user defined system or add to an existing system or to change certain parameters. The PARAM program allows the user to alter system parameters and to select options such as economics run, criticality analysis or sensitivity studies. The AVRAM program does a reliability analysis of the system.

0507 Fuels Production And Properties

REFER ALSO TO CITATION(S) 21581, 21582, 22031, 22166, 23350, 23558, 23559, 23562, 23607, 23608, 23609, 23611, 23612, 23613, 23614, 23615, 23616, 23696, 23888, 23896

0508 Spent Fuels Reprocessing

REFER ALSO TO CITATION(S) 21047, 21053, 21075, 22260

21035 **(CONF-880202—1) Design of a multisystem remote maintenance control room.** Draper, J.V.; Handel, S.J.; Kring, C.T.; Kawatsuma, S. (Oak Ridge National Lab., TN (USA); Power Reactor and Nuclear Fuel Development Corp., Tokyo (Japan)). 1988. Contract AC05-84OR21400. 17p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005067/JAW.

From International conference on the man-machine interface in the nuclear industry; Tokyo, Japan (15 Feb 1988).

The Remote Systems Development Section of the Consolidated Fuel Reprocessing Program at the Oak Ridge National Laboratory (ORNL) and Japan's Power Reactor and Nuclear Fuel Development Corporation (PNC) recently collaborated in the development of a control room concept for remote operations. This report describes design methods and the resulting control room concept. The design project included five stages. The first was compilation of a complete function list; functions are tasks performed by operators in the control room while operating equipment located in the remote area. The second step was organization of the function list into "function groups;" function groups are sets of functions that operate one piece of equipment. The third stage was determination of crew size and requirements for supervision. The fourth stage was development of conceptual designs of displays and controls. The fifth stage was development of plans for placement of crew stations within the control room. 5 figs., 1 tab.

21036 **(DOE/IG—0250) Economic discard limits for plutonium recovery.** (USDOE Office of Inspector General, Albuquerque, NM. Western Regional Office). 11 Feb 1988. 12p. OSTI, PO Bx 62, Oak Ridge, TN 37831. Order Number TI88006941/JAW.

Report to The Secretary.

Purpose of the audit was to determine whether the Department used economic discard limits (EDL) for the recovery of weapons-grade plutonium and whether the EDL calculations, if used, were current and accurate. Our review showed that EDL limits had not always been used or were not accurately calculated by some management and operating (M and O) contractors. This occurred because Department management had not updated or ensured implementation of EDL policy and procedures. Partial application of current EDL policy at two contractors prevented the unnecessary disposal of over $5.5 million in plutonium.

21037 **(IAEA-R—4441-F) Nuclear material inventory estimation in solvent extraction contractors II. Final report for the period September 1986-September 1987.** Beyerlein, A. (International Atomic Energy Agency, Vienna (Austria)). Nov 1987. 156p. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701045/JAW.

CUSEP-Clemson University Solvent Extraction Program.

The effectiveness of near-real-time nuclear materials accounting in reprocessing facilities can be limited by inventory variations in the separations contactors. Investigations are described in three areas: (i) Improvements in the model that the authors have described previously for the steady state inventory estimation in mixer-settler contactors, (ii) extension for the model for steady state inventory estimation to transient inventory estimation for non-steady state conditions, and (iii) the development of a computer model CUSEP (Clemson University Solvent Extraction Program) for simulating the concentration profiles and nuclear material inventories in pulsed column contactors. Improvements in the steady state model that are described in this report are the simplification of the methods for evaluating model parameters and development of methods for reducing the equation which estimates the total inventory of the set of contactors directly. The pulsed column computer model CUSEP (Clemson University Solvent Extraction Program) was developed. Concentration profiles and inventories calculated from CUSEP are compared with measured data from pilot scale contactors containing uranium. Excellent agreement between measured and simulated data for both the concentration profile and inventories is obtained, demonstrating that the program correctly predicts the concentration dispersion caused by pulsing and the dispersed phase holdup within the contactor.

21038 **(KFK—4208) Investigations into hydrazine free, electrochemical reduction of Pu(IV) in the Purex process.** Heilgeist, M.; Flory, K.; Galla, U.; Schmieder, H. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Heisse Chemie; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Wiederaufarbeitung und Abfallbehandlung). Dec 1987. 109p. (In German). (PWA—31/87). NTIS (US Sales Only), PC A06/MF A01. Order Number TI88752483/JAW.

In the Purex process applied to spent fuel element reprocessing the separation of uranium from plutonium is achieved by Pu(III) valence setting. In order to protect Pu(III) against oxidation by nitrous acid hydrazine is used as a nitrite capturing compound. According to the potential/pH diagrams (Pourbaix diagrams) of Pu and nitrogen compounds nitrous acid loses its oxidizing properties and even acts as a reductant for Pu(IV) if the nitric acid concentration is lowered to $\leqq$ 0.4 M. In this report the attempt was made to set the valence of Pu(III) electrochemically in the absence of hydrazine in a range of low acid concentration where nitrous acid has just lost its oxidizing properties. In experimental work on electrochemical valence setting for Pu(III) the following dependencies and influences were studied: Nitric acid concentration / current density / temperature / uranium content / electrode surface ratio / influence of extremely low hydrazine concentrations. Moreover, the reoxidation behavior was studied of the completely reduced Pu(III) containing solutions. The conclusions drawn from the laboratory experiments, that electrochemical U/Pu-separation is in principle possible without adding hydrazine, was confirmed by pulse column experiments with the TBP/dodecane/HNO/sub 3/-system.

21039 **(NUCLEBRAS-CDTN—537) Spent fuel management: reprocessing or storage.** Lima Soares, M.L. de; Oliveira Lopes, M.J. de. (Centro de Desenvolvimento da Tecnologia Nuclear, Belo Horizonte (Brazil)). 1986. 36p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number TI88701698/JAW.

A review of the spent fuel management concepts generally adopted in several countries is presented, including an analysis of the brazilian situation. The alternatives are the reprocessing, the interim storage and the final disposal in a repository after appropriate conditioning. The commercial operating reprocessing facilities in the Western World are located in France and in the United Kingdom. In the USA the anti-reprocessing policy from 1977 changed in 1981, when the Government supported the resumption of commercial reprocessing and designated the private sector as responsible for providing these services. Small scale facilities are operating in India, Italy, Japan and West Germany. Pilot plant for LWR fuel are being planned by Spain, Pakistan and Argentina.

0509 Transport And Storage

REFER ALSO TO CITATION(S) 22261

21040 **(CEA-CONF—9150) Study of stowage of radioactive materials packagings in accidental conditions.** Chevalier, G.; Gilles, P.; Phalippou, C.; Pouard, M.; Jolys, J.C.; Draulans, J.; Lafontaine, I. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete). Mar 1987. 10p. (In French). (CEA-DAS—346; CONF-8703240—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88752117/JAW.

From 2. national meeting on risk and safety in a transport system; Avignon, France (25 Mar 1987).

The study of transport conditions shows that few data are available on accidental conditions. Two types of accidents are selected and defined by calculations and tests. Sizing of stowage is determined for a frontal shock (35 g deceleration), maintaining the packaging on the vehicle, and side shock rupture of the stowage system for a determined stress. Mathematical formulations are developed.

21041 **(CEA-CONF—9151) Radioactive materials transport.** Ringot, C. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete). Mar 1987. 20p. (In French). (CEA-DAS—347; CONF-8703240—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88752116/JAW.

From 2. national meeting on risk and safety in a transport system; Avignon, France (25 Mar 1987).

Risks and transport regulations are reviewed, accent is put on the importance of packaging.

21042 **(ENEA-RT-DISP—85-2) Use of Intertran code for assessing radiation doses from the transport of radioactive wastes.** Mancioppi, S.; Piermattei, S. (ENEA, Rome (Italy)). 1985. 31p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700985/JAW.

The paper deals with the application of INTERTRAN code to the transport of radioactive wastes existing on the Italian territory. The exposure of the individuals involved is an important parameter to be considered in order to choose among different hypotetical sites located on the territory. The different modes of transport: truck and rail plus truck, have been considered. The application of the code is limited to normal conditions of transport.

21043 **(PINSTECH/NED—124) Criticality Study of PARR spent fuel storage.** Wasim, A.; Israr, M. (Pakistan Inst. of Nuclear Science and Technology, Rawalpindi. Nuclear Engineering Div.). Jun 1985. 8p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701220/JAW.

Sub criticality of PARR spent fuel storage is studied with the help of computer code WIMSD. The effective neutron multiplication factor, for type-II rack loaded with fresh standard fuel elements and having lattice pitch 16 cm, is calculated to be 0.62 which reduced to 0.53 with 30% burn-up K-infinity for type II storage rack, for fresh fuel is 0.69 and is 0.59 for 30% burn-up. Thus irradiated fuel storage capacity may be increased by placing another similar rack. K-infinity and K-effective at different lattice pitches are also calculated and plotted for fresh as well as for 30% burned standard fuel elements. Critical pitch value for fresh fuel is about 11.3 cm and that for irradiated fuel is 10.4 cm. (author). 4 refs., 4 figs. Kajang (MY).

21044 **(PNL-SA—15541) Results of studies on the behavior of spent fuel in storage.** Gilbert, E.R.; Bailey, W.J.; Johnson, A.B. Jr. (Pacific Northwest Lab., Richland, WA (USA)). Jan 1988. Contract AC06-76RL01830. 22p. (CONF-880125—2). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005526/JAW.

From Spent fuel storage seminar; Washington, DC, USA (20 Jan 1988).

Spent fuel integrity is a major consideration in licensing actions for spent fuel storage technologies. While wet storage continues to be the predominant US spent fuel management technology, dry storage has been licensed and implemented in the US. Rod consolidation technology is being developed and demonstrated. This paper summarizes the status of technology trends and understanding regarding fuel behavior for the three technologies. 32 refs., 3 figs., 4 tabs.

0510 Marketing, Economics, And By-products

21045 **(COGEMA-RA—1986) [The Compagnie Generale des Matieres Nucleares.] Annual progress report 1986.** (Compagnie Generale des Matieres Nucleaires (COGEMA), 78 - Velizy, Villacoublay (France)). 1987. 77p. (In French). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88752147/JAW.

Productivity, economics and action of COGEMA concerning uranium mines, enrichment, nuclear fuels, reprocessing recycling and transport are reviewed. A detailed financial report is given for the year 1986.

21046 **(INIS-XN—114) Nuclear energy and its fuel cycle, prospects to 2025.** (Nuclear Energy Agency, 75 - Paris (France)). 1987. 188p. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88701097/JAW.

Also published in French.

Nuclear power will supply an increasing share of the world's electricity but will expand more slowly than had been expected, and no shortages of uranium or other fuel cycle services are foreseen before the end of the century. While exploration for new uranium deposits should continue to ensure long-term supplies, advances in reactor design and enrichment and reprocessing techniques could achieve reductions in uranium demand.

21047 **(JAERI-M—86-169) Study of the application of a near-real-time materials accountancy system for a model plutonium conversion plants.** Ihara, H.; Ikawa, K. (Japan Atomic Energy Research Inst., Tokyo). Nov 1986. 117p. (In Japanese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE87702956/JAW.

An assessment was done on the potential capability of a near-real-time materials accountancy system for a model plutonium conversion plant. To this end, a computer simulation system, DYSAS-C, was developed and evaluated through this assessment study. This study showed that N.R.T.A system could be used not only as a good operator's accounting system but also as a useful inspectorate's system to detect an abrupt diversion. It also showed, however, that more elaborated NRTA system which have not yet evaluated in this study should be considerered when we wish to improve of detecting protracted diversion.

0520 Waste Management

REFER ALSO TO CITATION(S) 21036, 21964, 21980, 22019, 22104, 22423, 22857, 22861, 23226, 23227

21048 **(AERE-R—12083) Survey of chemical degradation processes in immobilised plutonium contaminated material.** Guest, M.J. (UKAEA Harwell Lab. Materials Development Div.). Sep 1987. 53p. (ILWRP—86/P12; DOE-RW—87.091). H.M. Stationery Office, London, price Pound 5.00.

The possible decomposition routes for organic waste materials (e.g. cellulose, polyvinyl chloride neoprene, polyethylene) under the high pH conditions expected in concrete pore water. The different types of organic material present in radioactive waste have been categorised according to their susceptibility to attack by alkali. Where possible the probable decomposition products have been identified and where possible their ability to form complexes with long lived radionuclides has been reviewed.

21049 **(AERE-R—12192) Effects of gamma irradiation on leaching of /sup 137/Cs from organic matrix waste forms.** Burnay, S.G.; Johnson, D.I.; Phillips, D.C.; Brownsword, M. (UKAEA Harwell Lab. Materials Development Div.; Department of the Environment, London (UK)). Sep 1987. 29p. (DOE-RW—86.130). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752350/JAW.

The effects of γ-irradiation on the leaching behaviour of /sup 137/Cs in organic matrix wasteforms has been studied. The matrix materials used include epoxide, polyester and vinyl ester thermosetting resins and bitumen. Leaching of /sup 137/Cs in such matrices can be described by models, based on diffusion, which take into consideration such factors as non-representative surface layers, finite sample size, and sorption effects. In many cases, the changes observed on irradiation arise from modification of the sorptive capacity of the wasteform for /sup 137/Cs, producing changes in the experimentally observed diffusion coefficients. In samples containing wet wastes, enhanced leaching in the first few days is observed after irradiation. This arises from loss of water from the sample surfaces during irradiation producing an enhanced concentration of the radionuclide in the surface.

21050 **(AERE-R—12481) Contamination and decontamination behaviour, under operational conditions, of improved surfaces being considered for alpha active environments.** Dalton, J.T.; Sutcliffe, P.W.; Wilkins, R.I.; Dawson, R.K.; Turner, A.D. (UKAEA Harwell Lab. Chemistry Div.). Oct 1987. 18p. (DDTF—P-105; PCMRP—86-P10; DOE-RW—87.045). H.M. Stationery Office, London, price Pound 4.00.

A range of surface finishes and coatings, both permanent and temporary have been evaluated in terms of their contamination/decontamination behaviour under realistic conditions within four operational glove boxes handling plutonium in a variety of different forms including oxide, metal and solutions. Disc samples housed within tiles were positioned in the glove boxes to represent wall and floor contamination. Examination after periods of exposure up to 150 days revealed relatively low levels of contamination, < 1 μg PuO/sub 2//sup -2/ in wall tiles and < 0.5 μg PuO/sub 2/cm/sup 2/ on the floor tiles, and no consistent trends in behaviour could be related to sample type. Decontamination factors were generally in the range of 2-15 following ultrasonic washing, and residual levels were also found not to be sample specific. Further exposure to higher contamination levels are recommended before reexamination is attempted.

21051 **(AERE-R—12538) Colloids related to low level and intermediate level waste. Progress report for the period 1st July 1986 to 30th December 1986.** Ramsay, J.D.F.; Avery, R.G. (UKAEA Harwell Lab. Chemistry Div.). Jul 1987. 30p. (DOE-RW—87.050). H.M. Stationery Office, London, price Pound 5.00.

Experimental investigations have been made to obtain basic information on the role of colloids in cement leaching mechanisms. Several cement formulations (pure OPC; OPC/BFS; OPC/PFA; OPC/silicafume) have been prepared for long-term leaching studies at different temperatures. Samples containing nuclide tracers, either separately or coprecipitated with ferric hydroxide floc have also been prepared to investigate radionuclide/colloid association. Interim light scattering measurements show there is a release of colloids in all leachates studies. These measurements provide data on colloid diffusion coefficients, hydrodynamic diameters, and concentration. The effect of ultrafiltration on colloid retention has been investigated in parallel with light scattering and scanning electron microscopy (SEM). There is evidence that colloidal particles arise by a process of nucleation and growth in solution. Chemical analysis on individual particles by EDAX shows a predominance of Si; Ca and traces of Ti and Al are also present with BFS cements. Initial inductively coupled mass spectrometry (ICP-MS) measurements on leachates from doped cements show that a dominant fraction released is associated with colloids. Investigations with different ultrafiltration membranes show that blocking and interaction of colloids in pores may occur with cement leachates and that ultracentrifugation may be a preferable colloid/liquid separation procedure.

21052 **(AERE-R—12557) Review of methods for the decontamination of alpha-bearing waste streams to very low-levels of activity.** Cross, J.E.; Hooper, E.W. (UKAEA Harwell Lab. Chemistry Div.). Jul 1987. 115p. (LETTF—86-P27; PCMRP—86-P15; DOE-RW—87.085). H.M. Stationery Office, London, price Pound 7.00.

This report reviews the processes presently available for the decontamination of alpha-bearing waste effluents. Evaporation, chemical precipitation, organic and inorganic ion exchange, solvent extraction, ultrafiltration, electrical and microbiological processes are considered in turn. Each type of process and its applications in the nuclear industry are briefly described together with the results from any recent development studies. From the information available the advantages and limitations of the process for alpha removal to low-levels (10/sup -2/-10/sup -3/ Bq/msup(l)) are assessed. It is concluded that no single process is capable of removing the actinides to these very low levels but that this level of decontamination should be achieved by the use of two or more processes either sequentially or in combination; e.g. the use of ultrafiltration or precipitation processes in combination with finely divided inorganic ion exchange materials. Processes involving a good solid-liquid separation, such as ultrafiltration appear to be the most appropriate for actinides which show a tendency to hydrolyse and form colloids. However, there is very limited information available on the removal of actinides by such processes, particularly at levels < Bq/ml. Electrical and biological processes are not yet sufficiently developed for their potential to be properly assessed.

21053 **(AERE-R—12830) Prospects for the separation and utilisation of valuable fission products from high level wastes.** Bush, R.P.; Acres, G.J.K. (UKAEA Harwell Lab. Chemistry Div.). Oct 1987. 29p. H.M. Stationery Office, London, price Pound 5.00.

A brief preliminary survey of other major elements present in irradiated PWR fuel in terms of their yields, activities, utilities and values, has been made. No further elements were identified as being worthy of consideration for possible separation from high level wastes, except for the useful radio isotopes /sup 137/Cs and /sup 90/Sr. Much work has been reported on separation techniques for caesium and strontium, but much of it is not relevant to their extraction from the high level liquid waste from commercial reprocessing plants, which is typically acidic (3M in HNO/sub 3/), highly active and complex in composition. This situation has been highlighted in a recent review which calls attention to the need for further R and D in this area. Candidate processes for further development are briefly discussed.

21054 **(BMI/ONWI—668) TEMP: A finite line heat transfer code for geologic repositories for nuclear waste.** Wurm, K.J.; Bloom, S.G.; Atterbury, W.G.; Hetteberg, J.R. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). Oct 1987. Contract AC02-87CH10290;AC02-83CH10140. 354p. NTIS, PC A16/MF A01; 1; GPO Dep. Order Number DE88006216/JAW.

TEMP is a FORTRAN computer code for calculating temperatures in a geologic repository for nuclear waste. It will calculate the incremental temperature contributed by a single heat source, by an infinite array of heat sources, or by heat sources geometrically arranged in a finite array. In the finite array geometry, different types of heat sources can be placed in different regions at different times to more closely approximate the emplacement of waste in a repository. TEMP uses a semi-analytical technique for solving the equation for a heat producing finite length line source in an infinite and isotropic medium. Temperature contributions from individual heat sources are superimposed to determine the temperature at a specific location and time in a repository of multiple heat sources. Thermal conductivity of the geologic medium can be a function of temperature, and, when it is, an approximation is made for the temperature dependence of thermal diffusivity. This report derives the equations solved by TEMP and documents its accuracy by comparing its results to known analytical solutions and to the finite-difference and finite-element heat transfer codes HEATING5, HEATING6, THAC-SIP-3D, SPECTROM-41, and STEALTH-2D. The temperature results from TEMP are shown to be very accurate when compared to the analytical solutions and to

the results from the finite-difference and finite-element codes. 8 refs., 97 figs., 39 tabs.

21055 **(BNL—40645) Mass transfer from penetrations in waste containers.** Pescatore, C.; Sastre, C. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 10p. (CONF-8711100—5). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005604/JAW.

From Symposium on the scientific basis for nuclear waste management; Boston, MA, USA (30 Nov 1987).

Recent studies have indicated that localized corrosion of a relatively small area of a waste container may impair the containment function to such an extent that larger releases may be possible than from the bare waste form. This would take place when a large number of holes coexist on the container while their concentration fields do not interact significantly with each other. After performing a steady state analysis of the release from a hole, it is shown that much fewer independent holes can coexist on a container surface than previously estimated. The calculated radionuclide release from multiple independent holes must be changed accordingly. Previous analyses did not proceed to a correct application of the linear superposition principle. This resulted in unacceptable physical conclusions and undue strain on the performance assessment necessary for a container licensing procedure. The paper also analyzes the steady state release from penetrations of finite length and whose concentration fields interact with one another. The predicted release from these penetrations is lower than the previously calculated release from holes of zero thickness. It is concluded here that the steady-state release from multiple holes on a waste container can not exceed the release from the bare waste form and that multiple perforations need not be a serious liability to container performance. 8 refs., 3 figs., 1 tab.

21056 **(CONF-870965—4) Detection and speciation of transuranium elements in synthetic groundwater via pulsed-laser excitation.** Beitz, J.V.; Bowers, D.L.; Doxtader, M.M.; Maroni, V.A.; Reed, D.T. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 16p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003040/JAW.

From International conference on chemistry and migration behavior of actinides and fission products in the geosphere; Munich, F.R. Germany (14 Sep 1987).

High sensitivity methods for detection and speciation of complexed transuranium ions in synthetic basalt groundwater, and simplified analogs, are being developed which exploit advances in pulsed laser technology. The first demonstration of high sensitivity detection of a transuranium ion at temperatures significantly above ambient is reported using laser photoacoustic spectroscopy (LPAS). The existence of enhanced LPAS signal amplitudes with increasing temperature in aqueous solution is confirmed in LPAS spectra recorded at 30 C, 60 C and 90 C using micromolar concentrations of /sup 241/Am/sup 3+/. A detection sensitivity of 8.5 parts per trillion (weight basis) of /sup 244/Cm/sup 3+/ in a simplified basalt groundwater at 22 C has been achieved using laser-induced fluorescence spectroscopy (LIF). This corresponds to 1 x 10/sup 8/ Cm/sup 3+/ ions in the laser beam. The detailed spectroscopic information obtained by this method points to the existence of previously unobserved Cm/sup 3+/ species. A brief assessment of the applicability and sensitivity of LPAS and LIF methods for speciating transuranium ions in near-neutral pH aqueous solution, such as the groundwater expected in a basalt nuclear waste repository, is presented. 27 refs., 3 figs.

21057 **(CONF-871038—11) Recent advances in centrifugal contactors design.** Leonard, R.A. (Argonne National Lab., IL (USA)). Oct 1987. Contract W-31109-ENG-38. 17p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005959/JAW.

From 5. symposium on separation science and technology for energy application; Knoxville, TN, USA (26 Oct 1987).

Advances in thedesign of the Argonne centrifugal contactor for solvent extaction are being realized as these contactors are built, tested, and used to implement the TRUEX process for the cleanup of nuclear waste liquids. These advances include (1) using off-the-shelf, face-mounted motors, (2) modifying the contractor so that relatively volatile solvents can be used, (3) adding a high-level liquid detector that can be used to alert the plant operator of process upsets, (4) providing secondary feed ports, (5) optimizing support frame design, (6) maintaining a linear design with external interstage lines so the stages can be allocated as needed for extraction, scrub, strip, and solvent cleanup operations, and (7) developing features that facilitate contractor operation in remote facilities. 11 refs., 8 figs.

21058 **(CONF-871124—78) The performance of actinide-containing SRL 165 type glass in unsaturated conditions.** Bates, J.K.; Gerding, T.J. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 12p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006000/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (30 Nov 1987).

As part of the effort by the Nevada Nuclear Waste Storage Investigations (NNWSI) Project to evaluate the volcanic tuff beds of Yucca Mountain, Nevada, as a repository for the permanent storage of high-level nuclear waste, the interaction of actinide-doped Savannah River Laboratory (SRL) 165 type glass with the unsaturated repository environment has been studied. The NNWSI Unsaturated Test method has been used, and the results from batch and continuous tests completed through 18 months demonstrate that several interactions are important for controlling both the reaction of the glass and the release of radionuclides. These interactions include (1) the reaction between the glass and moist air with interludes of liquid water contact, which results in the release of alkali metals from the glass; and (2) the reaction between standing water, glass, and presensitized 304 L type stainless steel which results in breakdown of the glass matrix and the release of radionuclides from the glass-metal assemblage. A comparison of the results of the Unsaturated Test with those of parametric experiments illustrates the importance of presensitized steel in enhancing the glass reaction, and demonstrates the applicability of the Unsaturated Test to those conditions anticipated to exist in the NNWSI repository horizon. 10 refs., 8 figs., 1 tab.

21059 **(CONF-880201—4) Activities in Department of Energy Hazardous and Mixed Waste, Defense Waste Management.** Eyman, L.D. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 23p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88005066/JAW.

From Waste management '88: symposium on radioactive waste management; Tucson, AZ, USA (26 Feb 1988).

Oak Ridge Operations Office (ORO) created the Hazardous Waste Remedial Actions Program Support Contractor Office (HAZWRAP SCO) to assist with the expanded lead assignment. The HAZWRAP SCO activities are currently supported by three distinct DOE-HQ funding elements: the Environmental Restoration Program, the Hazardous Waste Compliance Technology Program, and the Hazardous Waste Research and Development (R and D) Program. This paper will discuss those activities in the Hazardous Waste Compliance Technology Program and the Hazardous Waste R and D Program.

21060 **(DOE/ID—22072) Geologic data collected and analytical procedures used during a geochemical investigation of the unsaturated zone, Radioactive Waste Management Complex, Idaho National Engineering Laboratory, Idaho.** Rightmire, C.T.; Lewis, B.D. (Geological Survey, Idaho Falls, ID (USA)). Sep 1987. 89p. (USGS-OFR—87-246). NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88002595/JAW.

To assess the potential migration of low-level radioactive waste in the shallow subsurface it is necessary to understand the hydrogeologic and geochemical characteristics of the unsaturated zone. This data collection study was completed for the unsaturated zone at the Radioactive Waste Management Complex, Idaho National Engineering Laboratory, on the eastern Snake River Plain in southeastern Idaho. Geologic data were needed for input into a model of potential migration of waste that was buried in pits and trenches at the facility between the early 1950's and the early 1970's. Sample preparation and analytical techniques were required that would provide the needed information on geochemical charac-

teristics of the unsaturated zone. Examination of core and surficial sedimentary samples provided the needed data and analytical procedures were established following an intensive literature search. 22 refs., 10 figs., 1 tab.

21061 **(DOE-RW—87.099) Results of an exercise to incorporate measured data into subjective parameter distributions.** Dalrymple, G.; Johnson, K.; Phillips, L.; Smith, A.F.M. (Department of the Environment, London (UK)). Dec 1986. 51p. (CAP-S-TR-STH—24). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88752352/JAW.

The UK Department of the Environment (DoE) will require a sound methodology for assessing potential sites for the disposal of radioactive wastes. At the preliminary stages of a site assessment there will be little measured data available. At this stage the uncertainty associated with the parameter values are represented by pdfs elicited from subjective expert judgement. At the later stages of a site investigation measured data would become available. Bayesian methods can then be used to incorporate measured data into subjective pdfs. This report describes the results of three case studies which illustrate the feasibility of using Bayesian methods to update subjective prior distributions. The first case concerns the hydraulic conductivity of the vault backfill material and used a simple model of measurement errors. Following this, two cases were conducted on the conductivity of the Corallian aquifer underlying the Harwell site. These cases used a more complex model comprising multiple rock layers and a relationship with depth. All three cases show that Bayesian methods can be successfully used to update subjective pdfs and that the updated distributions incorporate the information contained in both the measured data and the prior distribution.

21062 **(DOE-RW—87.120) Assessments of future arisings of conditioned radioactive wastes for waste management system studies.** Beaven, G.; Potts, B.J. (Department of the Environment, London (UK)). Oct 1987. 159p. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88752358/JAW.

The report describes two assessments of conditioned radioactive waste arisings. One is based on existing and committed nuclear installations and the other on an assumed nuclear power generation scenario representing a moderate growth in nuclear generation. Radioactive wastes arise from: I. Commercial Nuclear Reactors, II. Fuel Cycle Activities, III. Research, Industrial and Medical activities. Decommissioning wastes are also considered. The study uses the SIMULATION 3 code which models waste material flows through a system of waste treatment and packaging to disposal. With a knowledge of the accumulations and average production rates of untreated wastes and their nuclide compositions (or total activities), the rates at which conditioned wastes become available for transportation and disposal are calculated, with specific activity levels.

21063 **(DOE/TIC—3311-S11) Radioactive waste processing and disposal: A bibliography.** McLaren, L.H. (ed.). (USDOE Office of Scientific and Technical Information, Oak Ridge, TN). May 1982. 866p. NTIS, PC A99/MF A01. Order Number DE82012480/JAW.

The Technical Information Center, beginning in 1958, has periodically issued bibliographies on radioactive wastes. This compilation contains 3382 citations of foreign and domestic research reports, journal articles, patents, conference proceedings, and books entered in the DOE Energy Data Base since December 1980. The citations are arranged by subject category as shown in the table of contents. Within a given category the arrangement is alphanumeric by report number. Citations of unnumbered documents are arranged in reverse chronological order after the reports. Each complete bibliographic record is followed by an abstract or a listing of the subject descriptors used to describe the contents of the reference for machine storage and retrieval. In many cases phrases or clauses that augment the title are also included. Five indexes, each preceded by a brief description, are provided: Corporate, Author, Subject, Contract Number, and Report Number.

21064 **(DOE/TIC—3406-Add.1) Nevada Nuclear Waste Storage Investigations, 1986: A bibliography.** Tamura, A.T.; Lorenz, J.J. (comps.). (USDOE Office of Scientific and Technical Information, Oak Ridge, TN). Jan 1988. 36p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE87012696/JAW.

This update contains information on the Nevada Nuclear Waste Storage Investigations (NNWSI) that was added to the Department of Energy's Energy Data Base during 1986. The preceeding initial bibliography (DOE/TIC-3406) covered 1977 to 1985 with indexing for: Corporate Author, Personal Author, Subject, Contract Number, Report Number, Order Number Correlation, and Key Word in Context. Future updates will be prepared on a six-month basis without indexing but will be cumulated at two-year intervals with complete indexing. This update is categorized by principal NNWSI Project participating organization, and items are arranged in chronological order. Participant-sponsored subcontractor reports, papers, and articles are included in the sponsoring organization's bibliography list.

21065 **(DOE/TIC—3406-Add.2) Nevada Nuclear Waste Storage Investigations, January-June 1987: An update.** Tamura, A.T.; Lorenz, J.J. (comps.). (USDOE Office of Scientific and Technical Information, Oak Ridge, TN). Mar 1988. 24p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88000455/JAW.

This update contains information on the Nevada Nuclear Waste Storage Investigations (NNWSI) that was added to the DOE Energy Data Base during the first six months of 1987. The update is categorized by principal NNWSI Project participating organization, and items are arranged in chronological order. Participant-sponsored subcontractor reports, papers, and articles are included in the sponsoring organization's list. The publication following this update will be a supplement to the first bibliography (DOE/TIC-3406) and will include all information retrieved from January 1, 1986, to December 31, 1987. It will be a cumulation of all updates for this two-year interval and will include indexing for: Corporate Author, Personal Author, Subject, Contract Number, Report Number, Order Number Correlation, and Key Word in Context.

21066 **(DPST—85-887) Groundwater numerical modeling studies at the Savannah River Plant: Status report.** Colven, W.P.; Killian, T.H.; Grant, M.W.; King, C.M.; Looney, B.B.; Marine, I.W.; Pepper, D.W.; Stephenson, D.E.; Root, R.W. Jr. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). Nov 1985. Contract AC09-76SR00001. 95p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88003318/JAW.

This document describes the current status of groundwater modeling studies being performed at the Savannah River Plant. The models used range from one-dimensional analytical solutions to complex three-dimensional numerical finite difference and finite element codes. Both fluid flow and solute transport calculations are being performed. A total of fourteen modeling studies are described, some having been completed and others being implemented. Seven of the studies involve the modeling of specific sites. Five are models of areas on the plantsite and two are regional models which include the plantsite. These studies are performed both in-house and by subcontractors. For each of the studies the results to date are summarized. A summary description of the various codes being used at the Savannah River Plant is presented in an appendix to facilitate comparison, determine applicability to specific types of problems, and point out difficulties. 17 refs., 27 figs.

21067 **(EGG-M—05787) Proposed decommissioning of radioactively contaminated NaK.** Brown, B.W.; Geimer, R.M.; LaRue, D.M.; Stoll, F.E.; Meservey, R.H.; Maggart, C.L. (EG and G Idaho, Inc., Idaho Falls (USA)). Oct 1987. Contract AC07-76ID01570. 10p. (CONF-871018—20). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005549/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

This paper deals with a proposed method for stabilizing radioactively contaminated eutectic sodium/potassium (NaK) liquid

metal. Approximately 680 liters (180 gal) of contaminated liquid NaK were generated in 1955 during testing with the Experimental Breeder Reactor (EBR-I) at the Idaho National Engineering Laboratory (INEL). Reaction of the NaK with chlorine gas to produce solid salts of sodium and potassium is proposed as a means to stabilize this waste. Preliminary testing was initiated to determine the reaction conditions required for this process. It was found that reaction with chlorine is feasible for safely treating the liquid metal.

21068 **(ENEA-RT-COMB—84-8) Hot bench scale plant Ester for the vitrification of high level wastes. The first vitrification campaign.** Nannicini, R.; Strazzer, A.; Cantale, C; Donato, A.; Grossi, G. (ENEA, Casaccia (Italy). Dip. del Ciclo del Combustibile). (ENEA, Rome (Italy)). 1985. 50p. (In Italian). NTIS (US Sales Only), PC A03/MF A01. Order Number TI88701720/JAW.

In this paper the hot bench-scale plant ESTER for the vitrification of the high-level radioactive wastes is described, and the main results of the first radioactive campaign are reported. The ESTER plant, which is placed in the ADECO-ESSOR hot cells of the C.C.R.-EURATOM-ISPRA, has been built and is operated by the ENEA, Departement of Fuel Cycle. It began operating with real radioactive wastes about 1 year ago, solidifying a total of 12 Ci of fission products into 2,02 Kg of borosilicate glass, corresponding to 757 ml of glass. During the vitrification many samples of liquid and gaseous streams have been taken and analyzed. A radioactivity balance in the plant has been calculated, as well as a mass balance of nitrates and of the /sup 137/Cs and /sup 106/Ru volatized in the process.

21069 **(GESD—88-19) AECL-US/DOE radioactive waste management technical cooperation program, 1985-1989: Subsidiary Agreement Number 1: Quarterly report to 1987 December 31.** (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment). Jan 1988. 40p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005836/JAW.

This report describes progress in cooperative experimental programs with the United States, rock mechanics studies, emplacement heating experiments, beforehole sealing tests, performance studies, computer codes, field tests, drilling procedures, shaft development, project engineering and funding. (TEM)

21070 **(HEDL-SA—3627) Predicting spent fuel oxidation states in a tuff repository.** Einziger, R.E.; Woodley, R.E. (Hanford Engineering Development Lab., Richland, WA (USA)). 1987. Contract AC06-76FF02170. 22p. (CONF-870437—3). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005708/JAW.

From Workshop on chemical reactivity of oxide fuel and fission product release; Gloucestershire, UK (6 Apr 1987).

Nevada Nuclear Waste Storage Investigations Project (NNWSI) is studying the suitability of the tuffaceous rocks at Yucca Mountain as a waste repository for spent fuel disposal. The oxidation state of the LWR spent fuel in the moist air environment of a tuff repository could be a significant factor in determining its leaching and dissolution characteristics. Predictions as to which oxidation states would be present are important in analyzing such a repository and thus the present study was undertaken. A set of TGA (thermogravimetric analysis) tests were conducted on well-controlled samples of irradiated PWR fuel with time and temperature as the only variables. The tests were conducted between 140 and 225°C for a duration up to 2200 hours. The weight gain curves were analyzed in terms of diffusion through a layer of U_3O_7, diffusion into the grains to form a solid solution, a simplified empirical representation of a combination of grain boundary diffusion and bulk grain oxidation. Reaction rate constants were determined in each case, but analysis of these data could not establish a definitive mechanism. 21 refs., 10 figs., 3 tabs.

21071 **(IAEA-TECDOC—446) In situ experiments for disposal of radioactive wastes in deep geological formations. Report prepared by a group of consultants.** (International Atomic Energy Agency, Vienna (Austria)). Dec 1987. 116p. NTIS (US Sales Only), PC A06/MF A01. Order Number TI88701739/JAW.

This report reviews the current status of in-situ experiments undertaken to assess various concepts for disposal of spent fuel and reprocessed high-level waste in deep geological formations. Specifically it describes in-situ experiments in three geological formations - clay, granite and domed salt. The emphasis in this report is on the in-situ experiments which deal with the various issues related to the near-field effects in a repository and the geological environment immediately surrounding the repository. These near-field effects are due to the disturbance caused by both the construction of the repository and the waste itself. The descriptions are drawn primarily from four underground research facilities: the Underground Experimental Facility, Belgium (clay), the Stripa Project, Sweden and the Underground Research Laboratory, Canada (granite) and the Asse Mine, Federal Republic of Germany (salt). 54 refs, figs and tab.

21072 **(INIS-mf—11115) Nondestructive techniques for the control of conditioned radioactive wastes. Feasibility study of a device based on computerized tomography.** Delprato, U. (Rome Univ. (Italy)). 1987. 134p. (In Italian). NTIS (US Sales Only), PC A07/MF A01. Order Number TI88701750/JAW.

The final product of the radwaste conditioning process must satisfy certain requirments and physico-chemical properties in order to assure its safe long-term behaviour. Of course, the foreseen quality assurance and quality control should be conducted by means of non-destructive techniques. This work presents an over-view of various applicable non-destructive methods of analysis, showing their fields of investigation in testing waste packages, together with some arising practical problems. The most promising methods, such as eddy current testing, ultrasonic testing, γ-scanning, γ-spectroscopy, neutron counting and computerized tomography, are treated more deeply and some applications are presented. Particular attention is devoted to the development of a device based on computerized tomography; its essential components are reported and some design problems are also discussed. 35 refs.

21073 **(K/QT—160) Sorptive removal of technetium from heavy metals sludge filtrate containing nitrate ion.** Bostick, W.D.; Evans-Brown, B.S. (Oak Ridge Gaseous Diffusion Plant, TN (USA); Oak Ridge National Lab., TN (USA)). Jan 1988. Contract AC05-84OT21400. 35p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005573/JAW.

We have found that cross-linked polyvinylpyridine (PVP) resin is more efficient than strongly basic anion-exchange resin for removal of technetium in wastes containing high concentrations of nitrate ion. Resin loading by nitrate is greatly reduced, and PVP resins are very stable with respect to chemical and radiological degradation. We have also found that the inexpensive inorganic reagents, elemental iron and ferrous sulfide, are very efficient for the removal of technetium and soluble mercury from aqueous nitrate wastes. The spent reactant and sorbent occupies a much smaller volume (per unit of technetium removed) than does organic resin, and the spent reactant can be immobilized into grout, with a very low leach rate for technetium. 30 refs., 5 figs., 13 tabs.

21074 **(LA—11026-MS) Assessment report on the kinetics of radionuclide adsorption on Yucca Mountain tuff.** Rundberg, R.S. (Los Alamos National Lab., NM (USA)). Jul 1987. Contract W-7405-ENG-36. 95p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88006031/JAW.

The kinetics of sorption was measured by observing the uptake of radionuclides by tuff wafers and crushed tuff as a function of time. In addition, the broadening of breakthrough curves for cations eluted through crushed-tuff columns was interpreted in terms of adsorption kinetics. The results of these measurements are consistent with a diffusion-limited adsorption mechanism for simple cations, such as strontium, cesium, and barium. The adsorption kinetics for these simple cations is sufficiently fast so that equilibrium can be assumed for the retardation of these chemical species in the groundwater velocities that would be reasonable for most release scenarios. The actinides, in particular plutonium, exhibited a slow time dependence for adsorption. 23 refs., 61 figs., 12 tabs.

21075 **(LA—11069-MS) Wastes from plutonium conversion and scrap recovery operations.** Christensen, D.C.; Bowersox, D.F.; McKerley, B.J.; Nance, R.L. (Los Alamos National Lab., NM (USA)). Mar 1988. Contract W-7405-ENG-36. 96p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88006270/JAW.

This report deals with the handling of defense-related wastes associated with plutonium processing. It first defines the different waste categories along with the techniques used to assess waste content. It then discusses the various treatment approaches used in recovering plutonium from scrap. Next, it addresses the various waste management approaches necessary to handle all wastes. Finally, there is a discussion of some future areas for processing with emphasis on waste reduction. 91 refs., 25 figs., 4 tabs.

21076 **(LA—11223-PR) Laboratory and field studies related to the Radionuclide Migration project: Progress report, October 1, 1986-September 30, 1987.** Thompson, J.L. (comp.). (Los Alamos National Lab., NM (USA)). Feb 1988. Contract W-7405-ENG-36. 29p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88006027/JAW.

In this report we describe the research done by personnel of the Los Alamos National Laboratory in support of the Radionuclide Migration project during FY 1987. We are engaged in collecting data concerning the movement of radionuclides at three locations on the Nevada Test Site. We continue to monitor the elution of tritium and krypton from the RNM-2S well at the Cambric site and have described in detail the elution of ^{36}Cl from the same well. The data from this field study provide us with the opportunity to test the validity of several models of solute transport through geologic media. We have detected tritium and fission products in a water sample from the hole UE20n #1, which was drilled this year at the Cheshire site on Pahute Mesa. We are also continuing our efforts to learn how radionuclides have moved in test areas 3 and 4 near the Aleman site. Our laboratory work this year includes (1) a characterization of the size and density of two stable plutonium(IV) colloid suspensions prepared by different techniques and (2) a study of the transmission of colloidal-size polystyrene beads through crushed-rock columns. 18 refs., 7 figs., 9 tabs.

21077 **(LBL—24494) Numerical simulation of alteration of sodium bentonite by diffusion of ionic groundwater components.** Jacobsen, J.S.; Carnahan, C.L. (Lawrence Berkeley Lab., CA (USA)). Dec 1987. Contract AC03-76SF00098. 15p. (CONF-871124—69). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005752/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (30 Nov 1987).

Experiments measuring the movement of trace amounts of radionuclides through compacted bentonite have typically used unaltered bentonite. Models based on experiments such as these may not lead to accurate predictions of the migration through altered or partially altered bentonite of radionuclides that undergo ion exchange. To address this problem, we have modified an existing transport code to include ion exchange and aqueous complexation reactions. The code is thus able to simulate the diffusion of major ionic groundwater components through bentonite and reactions between the bentonite and groundwater. Numerical simulations have been made to investigate the conversion of sodium bentonite to calcium bentonite for a reference groundwater characteristic of deep granitic formations. 20 refs., 2 figs., 2 tabs.

21078 **(NAGRA-NTB—84-38) Exploratory borehole Leuggern. Working program.** (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Jul 1984. 94p. (In German). Nagra, CH-5401 Baden, Switzerland.

An extensive geophysical borehole-logging programme will serve to verify results of core analysis and complement the core data. Numerous borehole logs are to be registered with different types of tools. These allow one to determine various parameters essential for the full description of the rock sequences penetrated. A first category of logs enables the petrographical identification of the different rock types and indicates porous zones that are either water- or hydrocarbon-bearing. A second category provides data e.g. on the degree of pore and fracture fill, rock density and rock temperature, natural gamma radiation and rock-mechanical properties. Other logs measure strike and dip of the sedimentary layers and the position of rock fractures. A fourth category provides information on the diameter and the deviation of the borehole, the quality of casing cementations, and the position of casing joints. In addition, well-shooting surveys will supply exact values of seismic velocities for the various rock units; data that are needed for the depth correction of the reflection profiles from Nagra's regional seismic network. With numerous hydrological tests ranging from a production tests of the Muschelkalk and Buntsandstein aquifers to labeled slug tests in low-permeability crystalline sections, the hydraulic conditions of deep groundwater flow will be investigated. The recovered water samples will undergo full physical and geochemical analysis. Furthermore, their isotope content is to be measured in order to estimate the age of the various formation waters and their time of residence in the subsurface. To round off the scientific investigations, a series of rock-mechanical and geotechnical laboratory tests will provide characteristic values to be applied eventually in the design and construction of shafts and caverns for an underground repository.

21079 **(NAGRA-NTB—84-39) Monitoring the radionuclide content of radioactive wastes.** Houriet, J.Ph. (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Nov 1984. 104p. (In French). Nagra, CH-5401 Baden, Switzerland.

It is possible to monitor the radionuclide content of wastes prior to disposal in a repository. On the basis of a preliminary waste inventory and characterisation together with provisional maximum permissible concentrations, a first analysis of the control requirements for a Type B repository (low- and intermediate-level wastes) was carried out. The study allowed a first determination of those cases where control appears to be important and of the nuclides and types of waste concerned. On the basis of possible monitoring techniques, a redundant monitoring system for the waste was outlined. The techniques and monitoring system proposed are provisional but they demonstrate that the aims of the control are feasible. The control system can only be fully optimized once the waste specifications associated with the end repository are finally defined.

21080 **(NAGRA-NTB—84-41) Potential of natural analogues in assessing systems for deep disposal of high-level radioactive waste.** Chapman, N.A.; McKinley, I.G.; Smellie, J.A.T. (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Dec 1984. 111p. Nagra, CH-5401 Baden, Switzerland.

Many of the processes which will lead to the breakdown of engineered barriers and the mobilisation of radionuclides in a deep waste repository have analogies in natural geological systems. These natural analogues are seen as a particularly important means of validating predictive models, under the broad heading of radionuclide migration, which are used in long-term safety analyses. Their principal value is the opportunity they provide to examine processes occuring over geological timescales, hence allowing more confident extrapolation of short timescales experimental data. This report begins by reviewing the processes leading to breakdown of containment in a high-level radioactive waste repository in crystalline bedrock and the subsequent migration mechanisms for radionuclides back to the biosphere. Nine specific processes are identified as being of the most significance in migration models, based on available sensitivity analyses. While the report is aimed specifically at the Nagra (Switzerland) and KBS (Sweden) concepts for disposal of high-level wastes or spent fuel, the results are seen to be more widely applicable. A considerable amount of the information reviewed and presented could be used in the assessment of disposal of other waste types in other host rocks.

21081 **(NAGRA-NTB—84-42) Final repository for high-level radioactive wastes. Safety-technical aspects of the operational phase.** (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Dec 1984. 80p. (In German). Nagra, CH-5401 Baden, Switzerland.

Compliance with applicable regulations and rules cannot completely prevent the occurence of incidents during the oper-

ational phase of a nuclear-waste repository. Incidents, breakdown of different equipment etc. could be caused despite such preventive measures by natural phenomena, by wear and tear of components, or by human error. This report addresses mainly the question, whether any unacceptable radiological release would occur from a disposal facility for high-level waste during its operational phase, either from routine operation or in the wake of operational incidents. The corresponding safety assessment is based on the conceptual type-C repository that was developed by Nagra and its contractors in the framework of Projekt Gewaehr 1985 and which is described in detail in Nagra report NTB 85-03. Three different kinds of waste are to be disposed of in this mine-type repository. They originate from reprocessing plants in which the spent fuel elements of nuclear reactors are treated. This report suggests numerous accident scenarios initiated by both repository internal and external causes. These scenarios are representative for waste-disposal facilities and they envelop all credible incident situations in such plants. In summary, with respect to radioactive exposures, it can be stated that no danger arises from the operation of the proposed type-C waste repository for the population and the environment.

21082 **(NAGRA-NTB—84-46) Determination of the sorption coefficient of uranium(VI) on Grimsel-and Boettstein-granite.** Wernli, B.; Bajo, C.; Bischoff, K. (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Sep 1984. 67p. (In German). Nagra, CH-5401 Baden, Switzerland.

A batch method has been used on powdered granites and the sorption coefficients (Rd) of uranium (VI) found are presented. Rock material from the Grimsel and from drill core at Boettstein were used. After quarrying and milling the granitic material, the specimens were gained by splitting the granitic powders: in this manner every sample was representative of the unbroken rock material. The particle-size distribution of the different rock materials was obtained by dry sieving the rock powders. A specific surface area between 260 and 330 cm^2/g for the different powders was found by using a standardized calculation model. The sorption coefficient was obtained by six different experimental series at room temperature and normal atmospheric conditions. The powdered rock samples were held in contact with the uranium containing solution. The measured Rd values are in good agreement with the values published in the literature. Only slight differences in the sorption behavior of the granites could be established in spite of different origin and different degree of weathering. For the sorption behavior of uranium (VI) on granite, an Rd value of at least 5 ml/g is desirable.

21083 **(NRPB-R—210) Radiological aspects of the management of solid wastes from the operation of D-T fusion reactors.** Davis, J.P.; Smith, G.M. (National Radiological Protection Board, Chilton (UK)). Nov 1987. 82p. H.M. Stationery Office, London, price Pound 6.00.

A range of structural materials are considered including conventional steels and low activation steels and alloys. waste management options considered are shallow land burial, deep geological disposal, deep ocean disposal, and recycling with useful product returned to the fusion reactor and disposal of secondary wastes. The implications of a range of intermediate cooling times are also examined. The main conclusions are that none of the waste materials considered is likely to be suitable for shallow land burial; for the other options there are no major post-disposal safety advantages in using the lower activation materials considered, although there will be operational advantages; recycle of wastes could have some post-disposal radiological advantages, but the impact on workers and the economic and strategic advantages need also to be taken into account; more information is required about the arisings of some radionuclides and their behaviour in recycling plant, the geosphere and biosphere, notably /sup 14/C and sup(186m)Re, in order to guide the further development of suitable candidate structural materials.

21084 **(NSS/G—101) Outline of Nirex's research and safety assessment programmes.** Saunders, P.A.H. (United Kingdom Nirex Ltd.). Nov 1987. 21p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752362/JAW.

This document outlines the safety studies being carried out by Nirex to ensure that radioactive wastes are disposed of in such a way that significant exposure of the public to radiation is at a minimum. The studies comprise experimental and theoretical work and mathematical modelling to predict performance over a long timescale. Laboratory experiments are concerned with the immobilisation and packaging of wastes. Field studies provide information on radionuclide migration and the geology of possible repository sites. The results should ensure that waste disposal meets the exacting government safety standards. (U.K.).

21085 **(NSS/R—101) Nirex safety assessment research programme: annual report for 1986/1987.** Cooper, M.J.; Hodgkinson, D.P. (eds.). (United Kingdom Nirex Ltd.). May 1987. 174p. (AERE-R—12698). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88752363/JAW.

This report describes research relating to the underground disposal of low-level and intermediate-level radioactive wastes, to provide information for post-emplacement radiological safety assessment. Topics reported are solubility and sorption, organic degradation, microbial activity, leaching, the corrosion of containers, and radionuclide migration studies. Properties of clays, slates, colloids and uranium disequilibrium are studied. Mathematical modelling to support the safety assessment of radioactive waste disposal is also studied. (U.K.).

21086 **(NUCLEBRAS-CDTN—528) Solid and liquid radioactive waste management of the Nuclear Technology Development Center (CDTN)- Nuclebras.** Guzella, M.F.R.; Mourao, R.P.; Reis, L.C.A.; Silva, E.M.P.; Miaw, S.T.W.; Prado, M.A.S.; Santos, P.O. (Centro de Desenvolvimento da Tecnologia Nuclear, Belo Horizonte (Brazil)). 1986. 34p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number TI88701695/JAW.

Low level liquid and solid wastes are produced in several laboratories of the NUCLEAR TECHNOLOGY DEVELOPMENT CENTER (CDTN) - NUCLEBRAS. In the last years, the intensification of technical activities at the Center has increased the radioactive waste volumes. Therefore, the implementation of a Radioactive Waste Management Program has begun. This Program includes the systematic of activities from the waste collection to the transportation for the final disposal. The liquid and solid waste are collected separately in proper containers and stored for later treatment according to the processes available or under development at the Center.

21087 **(NUREG—1298) Qualification of existing data for high-level nuclear waste repositories: Generic technical position.** Altman, W.D.; Donnelly, J.P.; Kennedy, J.E. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of High-Level Nuclear Waste Management). Feb 1988. 23p. NTIS, PC A03/MF A01 - GPO. Order Number TI88900314/JAW.

This document provides guidance on methods of qualifying data not initially collected under a 10 CFR Part 60, Subpart G quality assurance (QA) program. The license applicant for a geologic repository must demonstrate that the applicable health, safety, and environmental regulations in 10 CFR Part 60 have been met. Confidence in the data used to support the license application is obtained through a QA program. Some data which have not been initially generated under a 10 CFR Part 60, Subpart G QA program may be needed to support a license application to construct and operate a geologic repository. This document provides guidance on the use and qualification of data not initially collected under a Subpart G, QA program.

21088 **(NUREG/CR—4879-Vol.1) Demonstration of performance modeling of a low-level waste shallow-land burial site: A comparison of predictive radionuclide transport modeling versus field observations at the nitrate disposal pit site, Chalk River Nuclear Laboratories.** Robertson, D.E.; Bergeron, M.P.; Myers, D.A.; Abel, K.H.; Thomas, C.W.; Champ, D.R.; Killey, R.W.; Moltyaner, G.L.; Young, J.L. (Pacific Northwest Lab., Richland, WA (USA)). Nov 1987. Contract AC06-76RL01830. 134p. (PNL—6175-Vol.1). NTIS, PC A07/MF A01 - GPO. Order Number TI88005710/JAW.

Before a license can be obtained to construct a facility for the shallow-land burial of low-level wastes, the US Nuclear Regulatory Commission must be assured that the facility will meet both performance objectives and prescriptive requirements set forth in 10CFR61, Licensing Requirements for Land Disposal of Radioactive Waste. Subpart D of 10CFR61 states that a disposal site shall be capable of being characterized, modeled, analyzed and monitored. To test the concept of site modelability, a 30-year old low-level radioactive waste disposal site at Chalk River Nuclear Laboratories (CRNL), Canada, was used as a field location for evaluating the process of site characterization and the subsequent modeling prediction of radionuclide transport from the site by groundwater. The radionuclide source term was a limestone-lined pit (since covered with soil) which in 1953 to 1954 received approximately 3800 liters of aqueous waste containing 1000 to 1500 curies of aged, mixed fission products, including 700 to 1000 curies of ^{90}Sr and 200 to 300 curies of ^{137}Cs. This evaluation was performed by comparing the actual measured radionuclide migration with predicted migration estimated from hydrologic/radionuclide transport models. This comparison provided valuable insights into the applicability of transport modeling, and to determining what level of effort is needed in site characterization at locations similar to the Nitrate Disposal Pit to provide the desired degree of predictive capabilities. 47 refs., 42 figs., 7 tabs.

21089 **(NUREG/CR—5041-Vol.2) Recommendations to the NRC for review criteria for alternative methods of low-level radioactive waste disposal: Task 2b: Earth-mounded concrete bunkers.** Denson, R.H.; Bennett, R.D.; Wamsley, R.M.; Bean, D.L.; Ainsworth, D.L. (Army Engineer Waterways Experiment Station, Vicksburg, MS (USA)). Jan 1988. 116p. NTIS, PC A06/MF A01 - GPO. Order Number TI88900451/JAW.

The US Army Engineers Waterways Experiment Station (WES) and US Army Engineer Division, Huntsville (HNDED) have developed general design criteria and specific design review criteria for the earth-mounded concrete bunker (EMCB) alternative method of low-level radioactive waste (LLW) disposal. An EMCB is generally described as a reinforced concrete vault placed below grade, underneath a tumulus, surrounded by filter-blanket and drainage zones. The tumulus is covered over with a low permeability cover layer and top soil with vegetation. Eight major review criteria categories have been developed ranging from the loads imposed on the EMCB structure through material quality and durability considerations. Specific design review criteria have been developed in detail for each of the eight major categories. 63 refs., 13 figs., 2 tabs.

21090 **(ORNL—6428) Deterministic uncertainty analysis.** Worley, B.A. (Oak Ridge National Lab., TN (USA)). Dec 1987. Contract AC05-84OR21400. 53p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88006139/JAW.

This paper presents a deterministic uncertainty analysis (DUA) method for calculating uncertainties that has the potential to significantly reduce the number of computer runs compared to conventional statistical analysis. The method is based upon the availability of derivative and sensitivity data such as that calculated using the well known direct or adjoint sensitivity analysis techniques. Formation of response surfaces using derivative data and the propagation of input probability distributions are discussed relative to their role in the DUA method. A sample problem that models the flow of water through a borehole is used as a basis to compare the cumulative distribution function of the flow rate as calculated by the standard statistical methods and the DUA method. Propogation of uncertainties by the DUA method is compared for ten cases in which the number of reference model runs was varied from one to ten. The DUA method gives a more accurate representation of the true cumulative distribution of the flow rate based upon as few as two model executions compared to fifty model executions using a statistical approach. 16 refs., 4 figs., 5 tabs.

21091 **(ORNL/TM—10440) A compilation of the electricity generated and low-level radioactive wastes shipped for disposal by US nuclear power plants, 1959-1985.** Kibbey, A.H.; DePaoli, S.M. (Oak Ridge National Lab., TN (USA)). Dec 1987. Contract AC05-84OR21400. 95p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88006048/JAW.

The LWRDATA data base contains both volume and radioactivity data on nearly all the low-level radioactive waste (LLW) shipments from commercial boiling-water reactor (BWR) and pressurized-water reactor (PWR) nuclear power plants from 1959 through 1985. The corresponding net electrical output is also included in the data base. This report compares the various physical forms of LLW (i.e., wet; dry, compressible; irradiated, non-fuel core component; and miscellaneous) generated by BWR and PWR plants on the basis of their annual net electricity generation. Further comparisons are made of three specific categories of BWRs based on their size and condensate polishing systems: (1) small deep-bed plants, (2) large deep-bed plants, and (3) filter-demineralizer plants. The various types and volumes of PWR wastes generated per net megawatt (electrical)-year are also compared by nuclear steam supply system manufacturer. Limitations of the available data are discussed. 25 refs., 30 figs., 5 tabs.

21092 **(PNL—6019) Laboratory leach tests of phosphate/sulfate waste grout and leachate adsorption tests using Hanford sediment.** Serne, R.J.; Martin, W.J.; McLaurine, S.B.; Airhart, S.P.; LeGore, V.L.; Treat, R.L. (Pacific Northwest Lab., Richland, WA (USA)). Dec 1987. Contract AC06-76RL01830. 296p. NTIS, PC A13. Order Number DE88005864/JAW.

An assessment of the long-term risks posed by grout disposal at Hanford requires data on the ability of grout to resist leaching of waste species contained in the grout via contact with water that percolates through the ground. Additionally, data are needed on the ability of Hanford sediment (soil) surrounding the grout and concrete vault to retard migration of any wastes released from the grout. This report describes specific laboratory experiments that are producing empirical leach rate data and leachate-sediment adsorption data for Phosphate-Sulfate Waste (PSW) grout. The leach rate and adsorption values serve as inputs to computer codes used to forecast potential risk resulting from the use of ground water containing leached species. In addition, the report discusses other chemical analyses and geochemical computer code calculations that were used to identify mechanisms that control leach rates and adsorption potential. Knowledge of the controlling chemical and physical processes provides technical defensibility for using the empirical laboratory data to extrapolate the performance of the actual grout disposal system to the long time periods of interest. 59 refs., 83 figs., 18 tabs.

21093 **(PNL—6315-1) Hanford Site ground-water monitoring for April through June 1987.** Evans, J.C.; Mitchell, P.J.; Dennison, D.I. (Pacific Northwest Lab., Richland, WA (USA)). Jan 1988. Contract AC06-76RL01830. 237p. NTIS, PC A11. Order Number DE88005360/JAW.

Pacific Northwest Laboratory (PNL) is conducting groundwater monitoring at the Hanford Site. Results for monitoring by PNL and Westinghouse Hanford Company (WHC) during April-June 1987 show that certain regulated hazardous materials and radionuclides exist in Hanford Site ground waters. The presence of regulated constituents in the ground water derives both from site operations and from natural sources. The major contamination problems defined by recent monitoring activities are carbon tetrachloride in the 200 West Area; cyanide in and north of the 200 East Area; hexavalent chromium contamination in the 100B, 100D, 100K, and 100H areas; chlorinated hydrocarbons in the vicinity of the Central Landfill; uranium at the 216-U-1 and 216-U-2 cribs in

the 200 West Area; tritium across the site; and nitrate across the site. The distribution of hazardous materials related to site operations is more limited than the distribution of tritium and nitrate. 8 refs., 22 figs., 5 tabs.

21094 **(PNL—6333) The effects of composition on glass dissolution rates: The application of four models to a data base.** Geldart, R.W.; Kindle, C.H. (Pacific Northwest Lab., Richland, WA (USA)). Jan 1988. Contract AC06-76RL01830. 74p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88005567/JAW.

Four models have been applied to a data base to relate glass dissolution in distilled water to composition. The data base is used to compare the precisions obtained from the models in fitting actual data. The usefulness of the data base in formulating a model is also demonstrated. Two related models in which the composite or pH-adjusted free energy of hydration of the glass is the correlating parameter are compared with experimental data. In a structural model, the nonbridging oxygen content of the glasses is used to correlate glass dissolution rate to composition. In a model formulated for this report, the cation valence and the oxygen content of the glass are compared with observed dissolution rates. The models were applied to the 28-day normalized silica release at 90°C for over 285 glass compositions with surface area to volume ratios of 10 m^{-1} (Materials Characterization Center MCC-1 glass durability test using distilled water). These glasses included the nonradioactive analogs of WV205 and SRL-165, as well as SRL-131, PNL 76-68, and a European glass, UK209. Predicted glass dissolution rates show similar fits to the data for all four models. The predictions of the models were also plotted for two subsets of the glasses: waste glasses and Savannah River Laboratory glasses. The model predictions fit the data for these groups much better than they fit the data for the entire set of glasses. 14 refs., 12 figs., 7 tabs.

21095 **(PNL—6392) A field guide for well site geologists: Cable tool drilling.** Last, G.V.; Liikala, T.L. (Pacific Northwest Lab., Richland, WA (USA)). Dec 1987. Contract AC06-76RL01830. 37p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005541/JAW.

This field is intended for use by Pacific Northwest Laboratory well site geologists who are responsible for data collection during the drilling and construction of monitoring wells on the Hanford Site. This guide presents standardized methods for geologic sample collection and description, and well construction documentation. 5 refs., 5 figs., 2 tabs.

21096 **(PNL-SA—14878) Simulation used to qualify nuclear waste glass for disposal.** Reimus, T.W.; Kuhn, W.L. (Pacific Northwest Lab., Richland, WA (USA)). Jul 1987. Contract AC06-76RL01830. 10p. (CONF-871216—2). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88005524/JAW.

From Winter simulation conference; Atlanta, GA, USA (14 Dec 1987).

A hypothetical vitrification system was simulated errors associated with controlling and predicting the composition of the nuclear waste glass produced in the system. The composition of the glass must fall within certain limits to qualify for permanent geologic disposal. The estimated error in predicting the concentrations of various constituents in the glass was 2% to 8%, depending on the strategy for sampling and analyzing the feed and on the assumed magnitudes of the process uncertainties. The estimated error in controlling the glass composition was 2% to 9%, depending on the strategy for sampling and analyzing the waste and on the assumed magnitudes of the uncertainties. This work demonstrates that simulation techniques can be used to assist in qualifying nuclear waste glass for disposal. 3 refs., 2 figs., 4 tabs.

21097 **(PNL-SA—15092) Assessment of mixed hazardous and radioactive waste sites at Hanford.** McLaughlin, T.J.; Cramer, K.H.; Lamar, D.A.; Sherwood, D.R.; Stenner, R.D.; Schulze, W.B. (Pacific Northwest Lab., Richland, WA (USA); USDOE Richland Operations Office, WA). Oct 1987. Contract AC06-76RL01830. 10p. (CONF-870859—31). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005686/JAW.

From 9. annual low-level radioactive waste management program conference; Denver, CO, USA (25 Aug 1987).

The US Department of Energy and Pacific Northwest Laboratory recently completed a preliminary assessment of 685 inactive hazardous waste sites located on the Hanford Site. The preliminary assessment involved collecting historical data and individual site information, conducting site inspections, and establishing an environmental impact priority, using the Hazard Ranking System, for each of these 685 sites. This preliminary assessment was the first step in the remediation process required by the Comprehensive Environmental Response, Compensation and Liability Act. This paper presents the results of that preliminary assessment. 10 refs., 4 figs., 1 tab.

21098 **(PPA-CR—13) Report study on management of radioactive wastes in Malaysia.** Muhamat Omar; Syed Hakimi Sakuma Syed Ahmad. (Unit Tenaga Nuklear, Bangi, Selangor (Malaysia)). 1987. 12p. (In Malay). NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701707/JAW.

The national waste treatment centre at the Nuclear Energy Unit (N.E.U.) at Bangi was formed to manage all the radioactive wastes being produced in Malaysia. The aim of this study was to determine the condition of radioactive wastes being produced by radioisotope users and other relevant services that can be offered by N.E.U. to outside related agencies. Questionaires were sent to various government and private agencies which are expected to handle radioactive materials. The results show that most of the private agencies use radioactive sealed source while the government agencies use radioactive liquid and radioactive sealed source. The sealed source and liquid radioactive are mostly used for non-destructive testing and tracer studies, respectively. Radioactive gases are used mostly in electronic industries. An approximate value rate of volume and weight of liquid and solid wastes, respectively, produced per month was determined. Some important proposals were concluded in this study to improve the management of radioactive wastes in Malaysia.

21099 **(RFP—4026) Transuranic waste disposal in the United States.** Hoffman, R.B. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 1986. Contract AC04-76DP03533. 4p. (CONF-8610380—1). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88005141/JAW.

From ANS winter meeting; Washington, DC, USA (16 Oct 1986).

The United States is unique in having created a special class of radioactive waste disposal based on the concentration of transuranic elements in the waste. Since 1970, the US has been placing newly generated transuranic waste in retrievable storage. It is intended that these wastes will be placed in a permanent deep geologic repository, the Waste Isolation Pilot Plant (WIPP). WIPP opening for a demonstration emplacement period is set for October, 1988. Transuranic wastes derive from some of the manufacturing and research activities carried out by DOE. The bulk of this waste is generated in plutonium parts fabrication activities. A variety of plutonium contaminated materials ranging from glove boxes, HEPA filters, and machine tools, to chemical sludges derived from plutonium recovery streams are stored as TRU wastes. Other processes that generate TRU waste are plutonium production operations, preparation for and cleanup from fuel reprocessing, manufacturing of plutonium heat sources, and nuclear fuel cycle research activities.

21100 **(SAND—84-2641-Vol.2) Site characterization plan: Conceptual design report, Volume 2: Chapters 4-9: Nevada Nuclear Waste Storage Investigations Project.** MacDougall, H.R.; Scully, L.W.; Tillerson, J.R. (comps.). (Sandia National Labs., Albuquerque, NM (USA); Bechtel National, Inc., San Francisco, CA (USA); Parsons, Brinckerhoff, Quade and Douglas, Inc., San Francisco, CA (USA)). Sep 1987. Contract AC04-76DP00789. 537p. NTIS, PC A23. Order Number DE88003619/JAW.

This document presents a description of a prospective geologic repository for high-level radioactive waste to support the development of the Site Characterization Plan for the Yucca Mountain site. The target horizon for waste emplacement is a sloping bed

of densely welded tuff more than 650 ft below the surface and typically more than 600 ft above the water table. The conceptual design described in this report is unique among repository designs in that it uses ramps in addition to shafts to gain access to the underground facility, the emplacement horizon is located above the water table, and it is possible that 300- to 400-ft-long horizontal waste emplacement boreholes will be used. This report summarizes the design bases (site and properties of the waste package), design and performance criteria, and the design analyses performed. The current status of meeting the preclosure performance objectives for licensing and of resolving the repository design and preclosure issues is presented. The repository design presented in this report will be expanded and refined during the advanced conceptual design, the license application design, and the final procurement and construction design phases. 147 refs., 145 figs., 83 tabs.

21101 **(SAND—86-1580C) Modeling of multiphase flow in permeable media: (1) Mathematical model; (2) Analysis of imbibition and drying experiments.** Bixler, N.E.; Eaton, R.R. (Sandia National Labs., Albuquerque, NM (USA)). 1986. Contract AC04-76DP00789. 16p. (CONF-8607358—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002423/JAW.

From Gordon research conference on modelling of flow in permeable media; Andover, NH, USA (28 Jul 1986).

Calculating multiphase flow of water through fractured porous media, such as volcanic tuff, is a numerically challenging problem because of the highly nonlinear material characteristics of permeability and saturation which describe liquid and gas transport. Typically, the permeability of the fractured host rock being investigated for an underground nuclear waste repository at Yucca Mountain, Nevada increases by 15 orders of magnitude as the rock becomes saturated. Furthermore, permeability may vary by five orders of magnitude between geologic strata. Other nonlinear mechanisms - Knudsen diffusion, binary diffusion, vapor pressure lowering, and adsorption of vapor onto pore walls - may also strongly affect liquid and gas transport. In Part I of the presentation, the mathematical model and its computer implementation are presented. The application of these equations and solution procedures to problems related to underground waste repositories are addressed in Part II. Predicted results will be compared with the results of laboratory experiments in which a core of volcanic tuff has first undergone controlled imbibition, then drying. The importance of the various transport mechanisms is demonstrated by examining the predicted results. 14 figs.

21102 **(SAND—87-1913) Feasibility of disposal of high-level radioactive wastes into the seabed: Geoscience characterization studies.** Shephard, L.E.; Auffret, G.A.; Buckley, D.E.; Schuettenhelm, R.T.E.; Searle, R.C. (Sandia National Labs., Albuquerque, NM (USA); Institut Francais du Petrole (IFP), 92 - Rueil-Malmaison; Bedford Inst. of Oceanography, Dartmouth, Nova Scotia (Canada); Rijks Geologische Dienst, Haarlem; Institute of Oceanographic Sciences, Wormley (UK)). Jan 1988. Contract AC04-76DP00789. 324p. NTIS, PC A14/MF A01; 1; GPO Dep. Order Number DE88006226/JAW.

This report summarizes the results of the geoscience characterization studies that have been performed by investigators from member nations of the Seabed Working Group since its inception in 1979 and draws conclusions on geoscience feasibility using the data base established over this time. The results from this evaluation suggest, on the basis of available data, that sites may be found that will satisfy the geoscience requirements for a potential subseabed high-level waste repository. 276 refs.

21103 **(SAND—87-2230) Design evaluation: Structural calculations for the construction and salt handling shaft and the waste handling shaft at the Waste Isolation Pilot Plant (WIPP).** Torres, T.M. (Sandia National Labs., Albuquerque, NM (USA)). Feb 1988. Contract AC04-76DP00789. 40p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006691/JAW.

One fundamental strategy under consideration for sealing the Waste Isolation Pilot Plant (WIPP) shafts involves the consolidation of the salt backfill in specified portions of the shaft. The criterion for effective salt consolidation was defined to occur when the fractional density of the crushed salt reaches 95%. Thus, the shaft is sealed with a backfill material (crushed salt and/or precompacted salt blocks) that eventually develops properties considered favorable for long-term sealing purposes. This report describes the structural analyses performed to address how much deformation will occur in the shaft as a function of time and depth and how long will it take for the backfill to consolidate to 95% relative density. The two-dimensional axisymmetric shaft model was allowed to creep for a period of 30 years before instantaneous backfill emplacement. Results indicate that the backfill will consolidate to 95% density in less than 300 years at the repository horizon for an initial relative density of 0.60. Most of the backfill in the shaft reaches 95% density in less than 1000 years if the backfill is emplaced at an initial relative density of 0.85. Thus, the calculations show that salt seal materials can reconsolidate in the WIPP shafts to densities nearly equal to those for the intact host rock salt in a relatively short time span. 10 refs., 17 figs.

21104 **(SAND—87-2254) High-level waste management code maintenance and quality assurance.** Harlan, C.P.; Wilkinson, G.F. (Sandia National Labs., Albuquerque, NM (USA)). Jan 1988. Contract AC04-76DP00789. 51p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88006600/JAW.

The US Nuclear Regulatory Commission (NRC) has the responsibility of licensing sites for future disposal of commercial high-level radioactive waste. Sandia National Laboratories is assisting the NRC in this effort by developing and demonstrating performance assessment methodologies for evaluating high-level radioactive waste repositories in deep geologic formations. These methodologies include the development and application of computer programs. A computer software maintenance and quality assurance plan has been developed as a part of this effort. The plan and its implementation at Sandia are described in this report. 32 refs.

21105 **(SAND—87-2591) WIPP [Waste Isolation Pilot Plant] panel entryway seal: Numerical simulation of seal component/formation interaction for preliminary design evaluation.** Argueello, J.G.; Torres, T.M. (Sandia National Labs., Albuquerque, NM (USA)). Dec 1987. Contract AC04-76DP00789. 47p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006692/JAW.

This report presents the results of a series of structural analyses performed to evaluate the interaction of a potential two-component panel entryway seal configuration with the rock salt formation at the repository horizon of the Waste Isolation Pilot Plant. A two-dimensional plane strain geomechanical model of the configuration is used to numerically simulate and compute the interaction of each component with the formation. The structural response of the component itself and that of the formation, resulting from this interaction, is then evaluated. Issues addressed in this report pertain to the consolidation of the crushed salt component in terms of when effective consolidation is reached and to the stresses induced by the concrete component in terms of whether or not its presence in the seal system results in a tightening of the formation around the seal. 19 refs., 23 figs., 3 tabs.

21106 **(SAND—87-7076C) An analysis of air cooling prior to re-entering a drift containing emplaced commercial nuclear waste.** Wallace, K.G. Jr.; Zerga, D.P. (Mine Ventilation Services, Inc., Lafayette, CA (USA); Parsons, Brinckerhoff, Quade and Douglas, Inc., San Francisco, CA (USA)). Jan 1988. Contract AC04-76DP00789. 29p. (CONF-880126—1). NTIS, PC A03. Order Number DE88005170/JAW.

From TMS-AIME/ASM symposium on high temperature mechanical properties of ordered intermetallics; Phoenix, AZ, USA (25 Jan 1988).

This paper describes an analysis performed to determine the cool-down time of drifts in the prospective commercial nuclear waste repository in volcanic tuff at Yucca Mountain, Nevada. Two emplacement methods are currently being considered at Yucca Mountain. The reference configuration stores the high-level waste in short vertical boreholes, and the alternative configuration stores the waste in long horizontal boreholes. After emplacement oper-

ations for each emplacement drift are complete, the drift will be closed off from continuous ventilation. Given time, the radioactive decay of high-level waste will increase the rock temperature around access and emplacement drifts. Air cooling may be required to reenter these drifts. The paper discusses the analysis procedure and computer programs used to evaluate the time to cool a drift to acceptable environmental conditions 50 years after emplacement of high-level waste. Key assumptions to the analysis are presented. The results of the study show that cooling either vertical or horizontal configuration emplacement drifts is possible in a reasonable period of time. 4 refs., 5 figs., 2 tabs.

21107 **(SAND—87-7170) Rates of CO_2 production from the microbial degradation of transuranic wastes under simulated geologic isolation conditions.** Caldwell, D.E.; Hallet, R.C.; Molecke, M.A.; Martinez, E.; Barnhart, B.J. (New Mexico Univ., Albuquerque (USA). Dept. of Biology; Sandia National Labs., Albuquerque, NM (USA); Los Alamos National Lab., NM (USA); Midwest Research Inst., Kansas City, MO (USA)). Jan 1988. Contract AC04-76DP00789. 34p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006220/JAW.

Transuranic wastes containing organic matter can serve as an energy source for microbial growth. The rates of microbial respiration during decomposition of several transuranic-contaminated waste materials were measured under environmental conditions representative of a geologic waste repository in bedded salt. The major observed effect of microbial activity on organic-matrix wastes was the generation of CO_2 gas. Experimental variables studied include: incubation temperature (25° to 70°C), atmosphere (aerobic and anaerobic), moisture content, brine content, and plutonium contamination level (0 to 40 microcuries of alpha activity per gram of waste). The maximum rate of CO_2 generation observed was 11 g/day per gram of waste. The addition of 300 μg (20 μCi) of defense-grade PuO_2 per gram of waste reduced the rate of CO_2 generation by approximately 70%. Results indicate that microbial activity in existing drums of defense-related transuranic wastes has the potential to generate significant quantities of gas under both aerobic and anaerobic conditions. Carbon dioxide was the only gas detected in these studies. 42 refs., 1 fig., 6 tabs.

21108 **(SAND—88-0437C) The importance of scenario development in meeting 40 CFR Part 191.** Hunter, R.L. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 7p. (CONF-880201—10). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88006105/JAW.

From Waste management '88: symposium on radioactive waste management; Tucson, AZ, USA (26 Feb 1988).

Scenario development and screening is a fundamental part of performance assessment, but its importance in satisfying a standard is sometimes underestimated. The first step in scenario development in support of performance assessment for the standard's containment requirements is to identify a set of potentially disruptive events and processes. This set must be broad enough to allow the identification, as required by the standard, of those processes and events that might affect the disposal system; data can then be collected on the scenarios identified in this step. The standard also requires that releases be estimated for all significant processes and events; thus the final step in scenario development is systematically screening the scenarios, on the basis of their probabilities and consequences, to select those that are important enough to be modeled in detail. In general, a few hundred scenarios for the release of radionuclides from a nuclear-waste repository can be identified, but only a few of these can or should be modeled in detail. Without a description of the broad suite of scenarios that were originally considered, the regulator and the public would have difficulty in determining whether consequence modeling has been carried out for the appropriate processes and events. 17 refs.

21109 **(UCRL—21005) Corrosion testing of type 304L stainless steel in tuff groundwater environments.** Westerman, R.E.; Pitman, S.G.; Haberman, J.H. (Pacific Northwest Lab., Richland, WA (USA)). Nov 1987. Contract W-7405-ENG-48. 69p. (SANL—616-007; PNL—5829). NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88006242/JAW.

The stress-corrosion cracking (SCC) resistance of Type 304L stainless steel (SS) to elevated temperatures in tuff rock and tuff groundwater environments was determined under irradiated and nonirradiated conditions using U-bend specimens and slow-strain-rate tests. The steel was tested both in the solution-annealed condition and after sensitization heat treatments. The material was found to be susceptible to SCC in both the solution-annealed and solution-annealed-and-sensitized conditions when exposed to an irradiated crushed tuff rock environment containing air and water vapor at 90°C. A similar exposure at 50°C did not result in failure after a 25-month test duration. Specimens of sensitized 304 SS conditioned with a variety of sensitization heat treatments resisted failure during a test of 1-year duration in which a nonirradiated environment of tuff rock and groundwater held at 200°C was allowed to boil to dryness on a cyclical basis. All specimens of sensitized 304 SS exposed to this environment failed. Slow-strain-rate studies were performed on 304L, 304, and 316L SS specimens. The 304L SS was tested in J-13 well water at 150°C, and the 316L SS at 95°C. Neither material showed evidence of SCC in these tests. Sensitized 304 SS did exhibit SCC in J-13 well water in tests conducted at 150°C. 12 refs., 27 figs., 13 tabs.

21110 **(UCRL—21013) Summary of results from the Series 2 and Series 3 NNWSI [Nevada Nuclear Waste Storage Investigations] bare fuel dissolution tests.** Wilson, C.N. (Pacific Northwest Lab., Richland, WA (USA); Westinghouse Hanford Co., Richland, WA (USA)). Nov 1987. Contract W-7405-ENG-48. 15p. (CONF-8711100—2; PNL-SA—15207; HEDL-SA—3731A). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006030/JAW.

From Symposium on the scientific basis for nuclear waste management; Boston, MA, USA (30 Nov 1987).

The Nevada Nuclear Waste Storage Investigations (NNWSI) Project is studying dissolution and radionuclide release behavior of spent nuclear fuel in Nevada Test Site groundwater. Specimens were tested for multiple cycles in J-13 well water. The Series 2 tests were run in unsealed silica vessels under ambient hot cell air (25°C) for five cycles for a total of 34 months. The Series 3 tests were run in sealed stainless steel vessels at 25°C and 85°C for three cycles for a total of 15 months. Selected summary results from Series 2 and Series 3 tests with bare fuel specimens are reported. Uranium concentrations in later test cycles ranged from 1 to 2 μg/ml in the Series 2 Tests versus about 0.1 to 0.4 μg/ml in Series 3 with the lowest concentrations occurring in the 85°C tests. Preferential release of fission products Cs, I, Sr and Tc, and activation product C-14, was indicated relative to the actinides. Tc-99 and Cs-137 activities measured in solution after Cycle 1 increased linearly with time, with the rate of increase greater at 85°C than at 25°C. 8 refs., 8 figs., 3 tabs.

21111 **(UCRL—21019) Recent results from NNWSI [Nevada Nuclear Waste Storage Investigations] spent fuel leaching/dissolution tests.** Wilson, C.N. (Westinghouse Hanford Co., Richland, WA (USA)). Apr 1987. Contract AC06-76FF02170;W-7405-ENG-48. 26p. (SANL—622-027; HEDL-SA—3700-FP; CONF-870422—10). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005727/JAW.

From 89. annual meeting of the American Ceramic Society; Pittsburgh, PA, USA (26 Apr 1987).

The Nevada Nuclear Waste Storage Investigations (NNWSI) Project is studying dissolution and radionuclide release behavior of spent nuclear fuel in Nevada Test Site groundwater. Results from two-year extended testing of pressurized water reactor (PWR) spent fuel at 25°C in unsealed silica vessels are discussed. These results are compared to initial results from testing in sealed stainless steel vessels at 25°C and 85°C and to initial results from scoping experiments using oxidized spent fuel in unsealed silica vessels at 25°C.

21112 (UCRL—53645) Hydrothermal interaction of solid wafers of Topopah Spring Tuff with J-13 water and distilled water at 90, 150, and 250°C, using Dickson-type, gold-bag rocking autoclaves. Knauss, K.G.; Beiriger, W.J.; Peifer, D.W.; Piwinskii, A.J. (Lawrence Livermore National Lab., CA (USA)). Sep 1985. Contract W-7405-ENG-48. 57p. NTIS, PC E05/MF A01; 1; GPO Dep. Order Number DE88006145/JAW.

The Nevada Nuclear Waste Storage Investigations Project has conducted experiments to study the hydrothermal interaction of rock and water representative of a potential high-level waste repository at Yucca Mountain, Nevada. The results of these experiments help define the near-field repository environment during and shortly after the thermal period that results from the emplacement of nuclear waste. When considered in conjunction with results contained in companion reports, these results can be used to assess our ability to accelerate tests using the surface area/volume parameter and/or temperature. These rock-water interaction experiments were conducted with solid polished wafers cut from both drillcore and outcrop samples of Topopah tuff, using both a natural ground water and distilled water as the reacting fluid. Pre- and post-test characterization of the reacting materials was extensive. Post-test identification and chemical analysis of secondary phases resulting from the hydrothermal interactions were aided by using monoliths of tuff rather than crushed material. All experiments were run in Dickson-type, gold-bag rocking autoclaves that were periodically sampled at in situ conditions. A total of nine short-term (up to 66-day) experiments were run in this series; these experiments covered the range from 90 to 250°C and from 50 to 100 bar. The results obtained from the experiments have been used to evaluate the modeled results produced by calculations using the geochemical reaction process code EQ3/6. 31 refs., 37 figs., 7 tabs.

21113 (UCRL—96702) Geochemical simulation of reaction between spent fuel waste form and J-13 water at 25°C and 90°C. Bruton, C.J.; Shaw, H.F. (Lawrence Livermore National Lab., CA (USA)). Nov 1987. Contract W-7405-ENG-48. 12p. (CONF-8711100—4). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005724/JAW.

From Symposium on the scientific basis for nuclear waste management; Boston, MA, USA (30 Nov 1987).

Geochemical simulations of the degradation of spent fuel waste form in the presence of groundwater at the candidate Yucca Mountain, Nevada repository have been carried out to attempt to predict elemental concentrations in solution and to identity potential radionuclide-bearing precipitates. Spent fuel was assumed to dissolve congruently into a static mass of J-13 groundwater at 25°C and 90°C. Simulation results inidcate that haiweeite, soddyite, $Na_2U_2O_7$(c) and schoepite are potential U-bearing precipitates. $Na_2U_2O_7$(c) is only predicted to occur at 90°C. U concentrations in solution and the identity of the U-bearing precipitate depend on the activity of SiO_2(aq) in solution. U concentrations are limited to < 1 mg/kg when sufficient SiO_2(aq) exists in solution to precipitate uranyl silicates. Depletion of SiO_2(aq) in solution by the precipitation of silicates results in predicted increases of U concentrations to 87 and 619 mg/kg at 25°C and 90°C, respectively. Subsequent reaction and precipitation of schoepite cause U concentrations to decrease. Radionuclide other than U commonly precipitate as oxides in the simulations. The precipitation of solid phases appears to be extremely effective in limiting the concentrations of some radionuclides, such as Pu and Th, in solution. Increasing the temperature from 25°C to 90°C does not impact greatly the identify of precipitated phases or solution composition, except in the case of U. 7 refs., 7 figs., 2 tabs.

21114 (UCRL—97562) Impact of phase stability on the corrosion behavior of the austenitic candidate materials for NNWSI [Nevada Nuclear Waste Storage Investigations]. Bullen, D.B.; Gdowski, G.E.; McCright, R.D. (Science and Engineering Associates, Inc., Pleasanton, CA (USA); Lawrence Livermore National Lab., CA (USA)). Oct 1987. Contract W-7405-ENG-48. 12p. (CONF-8711100—3). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006243/JAW.

From Symposium on the scientific basis for nuclear waste management; Boston, MA, USA (30 Nov 1987).

The Nuclear Waste Management Program at Lawrence Livermore National Laboratory is responsible for the development of the waste package design to meet the Nuclear Regulatory Commission licensing requirements for the Nevada Nuclear Waste Storage Investigations (NNWSI) Project. The metallic container component of the waste package is required to assist in providing substantially complete containment of the waste for a period of up to 1000 years. Long term phase stability of the austenitic candidate materials (304L and 316L stainless steels and alloy 825) over this time period at moderate temperatures (100-250°C) can impact the mechanical and corrosion behavior of the metal barrier. A review of the technical literature with respect to phase stability of 304L, 316L and 825 is presented. The impact of martensitic transformations, carbide precipitation and intermediate (σ, chi, and eta) phase formation on the mechanical properties and corrosion behavior of these alloys at repository relevant conditions is discussed. The effect of sensitization on intergranular stress corrosion cracking (IGSCC) of each alloy is also addressed. A summary of the impact of phase stability on the degradation of each alloy in the proposed repository environment is included. 32 refs., 6 figs.

21115 (UKN—33) Nirex safety assessment research programme: 1987/1988. George, D.; Hodgkinson, D.P. (United Kingdom Nirex Ltd.). Jan 1987. 41p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752364/JAW.

The Nirex Safety Assessment Research programme's objective is to provide information for the radiological safety case for disposing low-level and intermediate-level radioactive wastes in underground repositories. The programme covers a wide range of experimental studies and mathematical modelling for the near and far field. It attempts to develop a quantitative understanding of events and processes which have an impact on the safety of radioactive waste disposal. (U.K.).

21116 (WINCO—1050) Inventories and properties of ICPP [Idaho Chemical Processing Plant] calcined high-level waste. Berreth, J.R. (Westinghouse Idaho Nuclear Co., Inc., Idaho Falls (USA)). Feb 1988. Contract AC07-84ID12435. 39p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006562/JAW.

The physical, chemical and radioactive properties are summarized for calcined high-level radioactive waste generated at the Idaho Chemical Processing Plant resulting from reprocessing of irradiated defense nuclear fuels. Most of the data presented has been collected from reports published in the open literature. Projections of future waste volumes are presented, as are the properties of a potential immobilized waste form. 47 refs., 8 figs., 21 tabs.

21117 (WVDP—88AR) [West Valley Demonstration Project]: Annual report. (West Valley Nuclear Services Co., Inc., West Valley, NY (USA)). Jan 1988. Contract AC07-81NE44139. 40p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006563/JAW.

FY 1987 accomplishments that were reported covered: high-level waste solidification; low-level and transuranic waste management; decontamination and decommissioning; site operations; and project management. Plans for FY 1988 and FY 1989 are also given. (DLC)

0530 Environmental Aspects

REFER ALSO TO CITATION(S) 21051, 21058, 21060, 21066, 21067, 21069, 21070, 21074, 21076, 21077, 21085, 21088, 21089, 21090, 21092, 21093, 21097, 21099, 21100, 21101, 21102, 21103, 21105, 21106, 21107, 21108, 21109, 21111, 21112, 21113, 21116, 21614, 22793

0540 Health And Safety

REFER ALSO TO CITATION(S) 21059, 21095, 21115, 22168

21118 (INIS-mf—10846, pp 59) **Selection of conditions for experimental radioactive contamination.** Simova, G.; Boyadzhiev, A.; Shopov, N.; Dimov, Ya. (Meditsinska Akademiya, Sofia, Bulgaria). Nov 1984. (In Bulgarian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

0550 Safeguards, Inspection, And Accountability

REFER ALSO TO CITATION(S) 21037, 21955

21119 **(CONF-871110—6-FP) The use of artificial intelligence for safeguarding fuel reprocessing plants.** Wachter, J.W.; Forgy, C.L. (Oak Ridge National Lab., TN (USA); Carnegie-Mellon Univ., Pittsburgh, PA (USA)). 1987. Contract AC05-84OR21400. 11p. NTIS, PC A03. Order Number DE88005053/JAW.

From 3. international conference on facility operations safeguards interface; San Diego, CA, USA (29 Nov 1987).

Recorded process data from the "Minirun" campaigns conducted at the Barnwell Nuclear Fuel Plant (BNFP) in Barnwell, South Carolina during 1980 to 1981 have been utilized to study the suitability of computer-based Artificial Intelligence (AI) methods for process monitoring for safeguards purposes. The techniques of knowledge engineering were used to formulate the decision-making software which operates on the process data customarily used for process operations. The OPS5 AI language was used to construct an Expert System for this purpose. Such systems are able to form reasoned conclusions from incomplete, inaccurate or otherwise "fuzzy" data, and to explain the reasoning that led to them. The programs were tested using minirun data taken during simulated diversions ranging in size from 1 to 20 L of solution that had been monitored previously using conventional procedural techniques. 13 refs., 3 figs.

21120 **(DP-MS—87-176) The changing Arena: New DOE waste management orders.** Albenesius, E.L.; Kluk, A.F. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). 1988. Contract AC09-76SR00001. 8p. (CONF-880201—8). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88005588/JAW.

From Waste management '88: symposium on radioactive waste management; Tucson, AZ, USA (26 Feb 1988).

There are five orders that address waste management within the Department of Energy (DOE); three of these orders are being revised, which emphasize the rapidly changing arena in which the department is contending in this field. The need to change the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) Order arose from the Superfund amendments of 1986 (SARA) with its hammer provisions in Section 120 for compliance at Federal facilities. The need to change the Hazardous and Mixed Waste Management Order was accelerated by the promulgation by DOE of the new mixed waste rule on May 1, 1987, (1) and cancellation of the obsolete existing order on October 5, 1987. The new rule requires coregulation of all DOE mixed waste with the Environmental Protection Agency (EPA) and the respective authorized states. 5 refs.

21121 **(IAEA-SAR—1) Report to the Director General on the twenty third series of SAGSI meetings, 11-15 May 1987.** (International Atomic Energy Agency, Vienna (Austria). Dept of Safeguards). Aug 1987. 41p. (CONF-8705251—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701046/JAW.

From Standing Advisory Group on Safeguards Implementation (SAGSI) meeting; Vienna, Austria (11 May 1987).

This report (on the twenty third series of meetings of SAGSI - Standing Advisory Group on Safeguards Implementation) deals with the following items (of the agenda): Discussion on measurement uncertainties; Issues relating to safeguarding OLR facilities; Consideration of 90(a) and 90(b) statements (by the IAEA to Member States on the results of inspections); Considerations of the long-term criteria; The agenda for the next SAGSI meeting. The following annexes are included: SAGSI Response to DDG(SG) Question Regarding the Role of C/S; SAGSI Advice on Safeguarding On-load Refuelled Power Reactors; Draft: 90(b) Statement. 2 tabs.

21122 **(LA—11196-MS) Statistical near-real-time accountancy procedures applied to AGNS [Allied General Nuclear Services] minirun data using PROSA.** Beedgen, R. (Los Alamos National Lab., NM (USA)). Mar 1988. Contract W-7405-ENG-36. 38p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005666/JAW.

The computer program PROSA (PROgram for Statistical Analysis of near-real-time accountancy data) was developed as a tool to apply statistical test procedures to a sequence of materials balance results for detecting losses of material. First applications of PROSA to model facility data and real plant data showed that PROSA is also usable as a tool for process or measurement control. To deepen the experience for the application of PROSA to real data of bulk-handling facilities, we applied it to uranium data of the Allied General Nuclear Services miniruns, where accountancy data were collected on a near-real-time basis. Minirun 6 especially was considered, and the pulsed columns were chosen as materials balance area. The structure of the measurement models for flow sheet data and actual operation data are compared, and methods are studied to reduce the error for inventory measurements of the columns.

21123 **(LA-UR—88-102) The use of safeguards data for process monitoring in the Advanced Test Line for Actinide Separations.** Barnes, J.W.; Yarbro, S.L. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 8p. (CONF-871110—20). NTIS, PC A02. Order Number DE88005381/JAW.

From 3. international conference on facility operations safeguards interface; San Diego, CA, USA (29 Nov 1987).

Los Alamos is constructing an integrated process monitoring/materials control and accounting (PM/MC & A) system in the Advanced Testing Line for Actinide Separations (ATLAS) at the Los Alamos Plutonium Facility. The ATLAS will test and demonstrate new methods for aqueous processing of plutonium. The ATLAS will also develop, test, and demonstrate the concepts for integrated process monitoring/materials control and accounting. We describe how this integrated PM/MC & A system will function and provide benefits to both process research and materials accounting personnel.

21124 **(NUREG—1100-Vol.4) Budget estimates fiscal year 1989: Appropriation, Salaries and expenses.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Budget and Analysis). Feb 1988. 146p. NTIS, PC A07/MF A01 - GPO. Order Number TI88900449/JAW.

The budget estimates for Salaries and Expenses for FY 1989 provide for obligations of $450,000,000 to be funded in total by a new appropriation. The sum appropriated shall be reduced by the amount of revenues received during fiscal year 1989 from licensing fees, inspection services, and other services and collections, excluding those monies received for the cooperative nuclear safety research program, services rendered to foreign governments and international organizations, and the material and information access authorization programs, so as to result in a final fiscal year 1989 appropriation estimated at not more than $247,500,000.

21125 **(NUREG—1304) Reporting of safeguards events.** Dwyer, P.A.; Ervin, N.E. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Reactor Inspection and Safeguards). Feb 1988. 25p. NTIS, PC A03/MF A01 - GPO. Order Number TI88900443/JAW.

On June 9, 1987, the Commission published in the Federal Register a final rule revising the reporting requirements for safeguards events. Safeguards events include actual or attempted theft of special nuclear material (SNM); actual or attempted acts or events which interrupt normal operations at power reactors due to unauthorized use of or tampering with machinery, components, or controls; certain threats made against facilities possessing SNM; and safeguards system failures impacting the effectiveness of the system. The revised rule was effective October 8, 1987. On September 14, 1987, the NRC held a workshop in Bethesda, MD, to answer affected licensees' questions on the final rule. This report documents questions discussed at the September 14 meeting, reflects a completed staff review of the answers, and supersedes previous oral comment on the topics covered.

0560 Legislation And Regulations

REFER ALSO TO CITATION(S) 21059, 21087

21126 **(INIS-XN—107) Radioactive Substances Act, 1957, No. 5.** (International Atomic Energy Agency, Vienna (Austria)). 17 Dec 1982. 14p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701090/JAW.

This Act as amended regulates the possession, sale and use of radioactive materials and irradiating apparatus. It sets up a Radiological Advisory Council to advise the competent authorities on questions within the scope of the Act, also with a view to radiation protection. The Council's rules of procedure are laid down. The Act also provides that, subject to prescribed exemptions, no person may hold, use or sell radioactive materials without a licence. (NEA).

21127 **(INIS-XN—108) Radioactive Substances Regulations, 1959 under the Radioactive Substances Act 1957.** (International Atomic Energy Agency, Vienna (Austria)). 27 Jan 1983. 63p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88701091/JAW.

These Regulations as amended lay down maximum permissible concentrations and doses and prescribe radiation protection measures for personnel. They provide for the licensing procedures for radioactive materials and irradiating apparatus and the conditions to be complied with for their handling, packaging, transport and disposal. The Schedules to the Regulations contain tables of maximum permissible radionuclide concentrations, models of licence application forms and labels. (NEA).

21128 **(INIS-XN—110) 7 June No. 54. Act amending Act No. 10 of 22 May 1902 (Penal Code).** (International Atomic Energy Agency, Vienna (Austria)). 7 Jun 1985. 1p. (In Norwegian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701093/JAW.

Norway as a Contracting Party to the Convention on the Physical Protection of Nuclear Material has complied with its obligations under the Convention by amending the Penal Code. The major amendment concerns sanctions with respect to nuclear materials. It is provided that any person who, without lawful authority, receives, possesses, uses, transfers, disposes of nuclear materials etc., thereby affecting the life, health or property of persons or the environment is liable to a fine or to a term of imprisonment not exceeding four years. Furthermore, any person creating such danger, which may result in loss of life or extensive damage to any other person's property, is liable to a severe penalty under the Code. (NEA).

21129 **(INIS-XN—111) Regulations for the use of radioactive sources on board Norwegian drilling platforms and other mobile drilling units, laid down by the Norwegian Maritime Directorate on 13 January 1986 pursuant to the Act of 9 June 1903 No. 7 relating to public control of the seaworthiness of ships etc.** (International Atomic Energy Agency, Vienna (Austria)). 13 Jan 1986. 8p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701094/JAW.

Translated from Norwegian original.

Under these Regulations, which entered into force on 15 February 1986, permits are required from the Maritime Directorate for the transport, storage and use of radioactive sources. When the radioactive source is carried by ship to the platforms, the operation is governed by the Regulations of 30 November 1979 on carriage by ships of special or dangerous cargo. The transport containers must comply with IAEA safety requirements. The storage room for the radioactive equipment must be marked with an appropriate warning sign and the distances between the room and other areas must comply with the relevant provisions of the IMO International Maritime Dangerous Goods Code. Personnel must be trained for work with radioactive sources and must wear dosimeters during this work. In addition, protective measures must be taken to prevent any harmful effects from radiation to such personnel and to the general crew on board the platform. (NEA).

21130 **(INIS-XN—116) Nuclear Activities (Prohibitions) Act 1983.** (International Atomic Energy Agency, Vienna (Austria)). 23 Jun 1983. 6p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701099/JAW.

The purpose of this Act is to protect the health and safety of the people of Victoria and its environment by prohibiting nuclear activities from being carried out and regulating the possession of certain nuclear material in a manner consistent with assisting Australia in meeting its international nuclear non-proliferation objectives. (NEA).

21131 **(INIS-XN—117) Uranium Mining and Nuclear Facilities (Prohibitions) Act 1986 No. 194.** (International Atomic Energy Agency, Vienna (Austria)). 18 Dec 1986. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701100/JAW.

The purpose of this Act is to protect the health and safety of the people of New South Wales and its environment. Accordingly it prohibits prospecting or mining for uranium and the construction and operation of nuclear reactors and other facilities in the nuclear fuel cycle. (NEA).

21132 **(INIS-XN—118) Regulations under the Radioactive Substances Act of 1958, No. 115, 1961.** (International Atomic Energy Agency, Vienna (Austria)). 25 Mar 1961. 35p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701101/JAW.

These very detailed regulations lay down the licensing system for the use of radioactive materials. They provide for monitoring and control of radiation and radiation contamination, storage, labelling and transport of radioactive materials and also for the disposal of radioactive waste. (NEA).

07 ISOTOPE AND RADIATION SOURCE TECHNOLOGY

0701 Physical Isotope Separation

21133 **Automatic system for the control of batch-produced $^{11}CO_2$ for continuous labeling experiments.** McKinney, C.J.; Fares, Y.; Magnuson, C.E.; Jaeger, C.H.; Goeschl, J.D.; Need, J.L. (Phytokinetics Division, PhytoResource Research Inc., 707 Texas Avenue, Suite 101-E, College Station, Texas 77840 and Botany Department Phytotron, Duke University, Durham, North Carolina 27706). *Review of Scientific Instruments;* **59**: No. 3, 467-469(Mar 1988).

A system for storage and continuous dispensing of constant activity $^{11}CO_2$ from batch production is described. The system has been used successfully to maintain constant activity levels for 2-h plant tracer kinetic experiments. This development now allows any existing cyclotron facility to supply a radioisotope stream continuously from a short batch irradiation. It requires no modification for use with other isotopes such as N-13 or O-15 in gaseous form and can be used in other biological and clinical investigations as well as the plant physiology investigations for which it was developed.

0702 Radiation Sources

REFER ALSO TO CITATION(S) 22413, 23725

21134 **(ENEA-RT-PAS—87-3) ENEA results in the international comparison organized by BIPM for the measurament of neutron fluxes of a Californium source.** Rotondi, E.; Raponi, F.; Ceravolo, L.; Gentilin, L.; Ientile, P.; Mancini, S.; Rondanina, A. (ENEA, Rome (Italy)). 1987. 60p. (In Italian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88700993/JAW.

During the period between May 1978 and August 1984 under the auspices of Section III of CCEMRI of CIPM it has been carried out the international intercomparison of Californium neutron source emission rate. The previous intercomparison was based on Ra-Be (α -n) source measuraments, which took place between 1959 and 1965, and the results showed a total spread of +- 3%. Owing to the better accuracy achived over the following decade the Ra-Be intercomparison was no longer representative of the state of the art, therefore it was decided to arrange the intercomparison based on Californium which in the meantime reached a wide use in the world. Contributions to the intercomparison were received from fourteen laboratories representative of twelve Nations plus the BIPM. The results put into evidence a considerable advance on accuracy in the neutron source emission rate measuraments. The standard deviation of the residuals obtained from least square fit of normalized data resulted +- 0,57%. In the present report it is widely described the Manganese bath method used at ENEA, CRE Casaccia in Roma, and the experimental procedure followed for its absolute calibration. All measuraments are reported and analysed, including those effectuated for corrective factors determination. The final results obtained at ENEA for the circulated Californium source is (3,457 +- 0,013) 10*H7 neutron/s. The analysis of data from all partecipantes has been effectuated and concluded by J. Axton in March 1986 and the conclusions which have been showed in the present report put in evidence the satisfactory results achived by the ENEA.

21135 (INIS-BR—934, pp 57) **Production of radiation sources for the calibration of X-ray detectors: /sup 55/Fe, / sup 57/Co and /sup 109/Cd.** Osso Junior, J.A. (Instituto de Engenharia Nuclear, Rio de Janeiro, Brazil. Dept. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701471/JAW. (CONF-8708216—).

From 10. workshop on nuclear physics in Brazil; Caxambu, MG, Brazil (26 Aug 1987).

21136 **(SAND—87-1606) Practical constraints on sources for pulsed beam lithographies.** Tsao, J.Y.; Picraux, S.T.; Light, R.W.; Hsing, W.W. (Sandia National Labs., Albuquerque, NM (USA)). Mar 1988. Contract AC04-76DP00789. 22p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006594/JAW.

Many of the sources currently being considered for advanced microlithography are pulsed, rather than continuous. These sources are characterized not merely by brightness and lifetime, but more generally by shot-to-shot stability, lifetime, single-pulse fluence, and repetition rate. These four characteristics are constrained by practical considerations, and, within limits, can be traded off against each other. We describe these tradeoffs and optimal source operating regimes for lithographies based on broad- and narrow-band excimer laser sources and on pulsed x-ray sources. 18 refs., 2 figs.

08 HYDROGEN

0801 Production

REFER ALSO TO CITATION(S) 20881

21137 (NEDOJ—8401, pp 706-714) **Development of hydrogen production plant. Research and development of hydrogen production plant by high-temperature high-pressure water electrolysis.** Aug 1984. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770050/JAW.

In FY 1983 NEDO Annual Report.

A pilot plant of high-temperature high-pressure hydroelectrolysis method was produced with a hydrogen-producing capacity of 20 Nm³/hour, and it was operated for research. In more detail, by the operation and research, the results were compared with the data on the test plant, and evaluated accordingly. At the same time, evaluation and test of the adaptability of structural metal materials, production of electrolyzer for pilot plant, improvement and cost-reduction study on electrodes, diaphragms, cell-composing materials, overhauling study of the test plant, and study of optimization of the plant system were performed. From the time factor, since the project was initiated by the commissioned research of the Sunshine Project in 1974 through 1976, a small type of hydro-electrolyzing device was advanced to a large pilot plant of 20 Nm³/hour class which was made in 1982. On this plant, element techniques were studied including a test on stress corrosion cracking of the structural metal materials, improvement of electrolyzed cell-composing elements, and study of the optimization of the system. (2 figs, 2 tabs)

21138 **(PB—88-157334/XAB) HTGR (high-temperature gas-cooled reactor) thermochemical water splitting for hydrogen production. Annual report, January 1, 1977-December 31, 1977.** (General Atomic Co., San Diego, CA (USA)). Apr 1978. 61p. (GA-A—14908). NTIS, PC A04/MF A01.

The report describes progress made during January to December 1977 of a program to investigate thermochemical water splitting using the high-temperature, gas-cooled reactor (HTGR) as a heat source. Material investigations were directed toward obtaining corrosion test data for metallic and nonmetallic materials in HIx media and establishing weight and surface changes as a function of time. Some metallic, plastic, and elastomeric materials resisted appreciable corrosion in HIx, although many materials screened were rapidly attacked. The refractory metals Ta, Mo, Nb-1 Zr, and Ta-10 W continued to show good resistance to HIx at room and elevated temperatures. Titanium and zirconium looked promising although titanium was severely attacked in high (82% by weight) I2 content HIx at elevated temperatures. The cast-iron-base alloy Durichlor continued to resist attack at room temperature. The perfluorocarbon elastomer Kalrez swelled only a minor amount and resisted attack at elevated temperature even under boiling condition. Teflon TFE and FEP showed some absorption of HIx with no apparent degradation.

21139 **(PB—88-160932/XAB) Solar-assisted hydrogen generation by photoelectrocatalysis. Annual report, November 1, 1986-October 31, 1987.** Sammells, A.F.; Cook, R.L.; Wessels, B.W. (Eltron Research, Inc., Aurora, IL (USA)). 7 Nov 1987. 136p. NTIS, PC A07/MF A01.

See also report dated May 83, PB—83-211904.

Carbon dioxide was electrochemically reduced at high rates and Faradaic efficiencies using in-situ deposited copper electrodes in CO_2 saturated potassium bicarbonate. Both methane and ethylene were found as reduction products. At a current density of 8.3mA/sq. cm. the cumulative yield for those two species was essentially Faradaic, and at 25mA/sq. cm. 79%. Carbon dioxide reduction did not appear to be a direct electrochemical process, but proceeded through the reaction of weakly adsorbed carbon dioxide with electrochemically generated chemisorbed hydrogen at the in situ deposited copper surface. Subsequent hydrogenation of this reduced species by chemisorbed hydrogen probably led to bridged CO groups which could either desorb to give carbon monoxide or become further reduced to give carbidic carbon available for subsequent hydrogenation to yield methane and ethylene. Carbon dioxide reduc-

tion to gaseous hydrocarbons was also promoted using solid polymer electrolyte cells, where the reaction occurred at less cathodic potentials than found in aqueous electrolyte.

0802 Storage

REFER ALSO TO CITATION(S) 21359

09 OTHER SYNTHETIC AND NATURAL FUELS

21140 **(NEDO-P—8521) Report on preliminary survey of biomass resources.** (New Energy Development Organization, Tokyo (Japan)). Mar 1986. 92p. (In Japanese). NTIS (US Sales Only), PC A05. Order Number DE88770053/JAW.

Biomass resources come to public notice as a part of the development of alternative energy. The special features of distribution of resources by the metropolis and districts were grasped and the biomass resources in Hokkaido as the model district were surveyed in detail. The amount of existing biomass resources in Japan is approximately one and a half billion tons and the forest land accounts for 94% of it. The amount of production of biomass and amount of available energy are approximately 160 million tons and approximately 100 million tons, respectively. Since the amount of production of biomass in Hokkaido is only 14% of that in Japan though the amount of existing biomass resources is 22%, the production capacity per unit area of land must be increased. The productions of alcohol from glucide and starch and the recovery of silicon for semiconductor (seven times the nationwide production) from rice hulls are promising. The productions of methane and compost from the other resources are expected. The promising areas of biomass resources in Hokkaido are Obihiro, Asahikawa and three regions along the shore of the Sea of Okhotsk. (21 figs, 29 tabs)

0901 Hydrocarbon Fuels

REFER ALSO TO CITATION(S) 20750, 21213, 21214, 21219, 22963, 22971, 22972

21141 (DOE/CH/10093—6, pp 58-60) **Oilseed crops for diesel fuel substitutes.** Butler, J.L. (Dept. of Agriculture, Beltsville, MD). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

Objectives are: (1) to develop and test nationally, broadly adapted cultivars of winter rapeseed, which could provide diesel substitutes; (2) to develop double-cropping techniques for winter rapeseed in the Southeast; and (3) to test small-scale extraction of vegetable oils from oilseed crops. A coordinated program has been developed that allows rapeseed breeding lines to be tested for seed yield and oil quality at 12 selected locations throughout the continental US. Oil quality indices of seed oil content and fatty acid composition are determined at Moscow, Idaho. Improved cultivars for the Pacific Northwest and the southeastern US are being developed using conventional and recently developed biotechnology. Winter and summer rapeseed varieties and peanuts are double-cropped at Tifton, Georgia. The effect of rapeseed planting date is examined. For small-scale extraction testing, a bench-scale carbon dioxide extraction system was constructed and peanuts used to test the system. A model to describe the extraction process is being developed. Preliminary results are given. 11 references.

21142 (DOE/CH/10093—6, pp 75-76) **Biochemical elucidation of neutral lipid synthesis in microalgae.** Cooksey, K.E. (Montana State Univ., Bozeman). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

The major objective of this project is to delineate the pathway(s) of neutral lipid synthesis in three representative strains of microalgae and to subsequently determine the regulation of the enzymes that control neutral lipid synthesis. For the purpose of this work, neutral lipids will be defined as triglycerides and hydrocarbons. Cells of the three selected microalgae in isotonic buffer will be broken in a French press or by use of a sonicator. In particular, intact chloroplasts will be sought. Cell homogenates in a buffered isotonic solution (sucrose of mannitol) will be separated on a sucrose or Percoll gradient by centrifugation. Fractions of the gradient will be characterized with respect to protein, density, and chlorophyll. The following enzymes will be measured in these cell fractions: acetyl CoA carboxylase, RUBP-carboxylase (chloroplast marker), fumarase (31) mitochondrial marker), malate dehydrogenase (31) (mitochondrial marker), and acetyl CoA synthetase. Labeled hydrocarbons in Botryococcus or Nanno Q experiments and others where appropriate will be quantified by radio-gas chromatography (radio-GC). Radio-GC of the hexane eluate from the silica column will give relative quantities of radioactivity in the individual hydrocarbons separated by chain-length on the GC. Relative incorporation of ^{14}C-acetate into the various fatty acids and into the various hydrocarbons will provide indications on the biosynthetic pathway of fatty acids to hydrocarbons.

21143 (DOE/CH/10093—6, pp 82) **Chrysophysean lipids: effect of induction on the quantity and type of lipids produced.** Sriharan, S. (Selma Univ., AL). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

The objective of this project is to complete a detailed characterization of lipids that accumulate in representative Chrysophytes during various induction strategies (i.e., silica limitation, nitrogen limitation, and temperature variation). The effort will concentrate on diatoms from saline environments. Three diatoms were cultured in a defined media. After acclimation (20°C, 30°C), cultures were grown under nitrogen and silica sufficient and deficient conditions and the algae analyzed for lipids. Finally, the lipids will be characterized.

21144 (DOE/CH/10093—6, pp 87-88) **Biochemistry of microalgal lipid production.** Roessler, P. (Solar Energy Research Institute, Golden, CO). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

The objectives of this project are to elucidate the biochemical pathway of lipid synthesis in diatoms and to determine the various biochemical mechanisms responsible for lipid accumulation in nutrient-starved cells. Research carried out thus far has determined that lipid accumulation in silicon-deficient Cyclotella cryptica cells is the result of two distinct processes: (1) increased partitioning of newly assimilated carbon into lipids and (2) slow conversion of previously fixed carbon into lipids. Since the altered carbon partitioning patterns appeared to be largely due to decreased storage carbohydrate (chrysolaminarin) biosynthesis, the enzymatic pathway responsible for the synthesis of this compound was determined. In addition, several enzymes associated with lipid biosynthesis in C. cryptica have been partially characterized, including acetyl-CoA synthetase and acetyl-CoA carboxylase.

21145 (DOE/CH/10093—6, pp 96) **Biochemical elucidation of neutral lipid synthesis in microalgae.** Schwartzbach, S. (Univ. of Nebraska, Lincoln). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

The major objective of the research is to elucidate, at the enzyme level, the regulation of rapid lipid synthesis. Specific objectives of this subcontract were to (1) determine conditions for the maximum induction of neutral lipid synthesis in three taxonomically distinct species of microalgae. Triggers to be used will be anaerobiosis, temperature, and nitrogen starvation; (2) determine if de novo protein synthesis is required for the induction of neutral lipid synthesis, and if so, determine which polypeptides are induced by the lipid trigger; and (3) identify and elucidate the regulatory mechanism of the controlling enzymes responsible for lipid trigger responses in oil-producing strains of microalgae. Initial experiments determined conditions for the optimal induction of lipid synthesis. Algae were cultured on defined media containing varying concen-

trations of the presumed nutrient whose depletion triggers lipid synthesis - nitrogen, sulfur, or phosphate. A survey of the enzymes responsible for acetyl-CoA and malonyl CoA synthesis in each of three species of microalgae was made and finally it was determined if de novo protein synthesis is involved in the induction of lipid synthesis.

21146 (DOE/CH/10093—6, pp 138-139) **Pilot study on microbial populations in sanitary landfills.** Bogner, J.E. (Argonne National Lab., IL). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

The objective of this project is to determine the feasibility of managing landfill gas production in situ by manipulation of microbial populations and/or environmental factors (pH, moisture, nutrients). Depth-based samples across several lateral transects at a sanitary landfill with a mesophilic temperature regime will be collected for laboratory incubation. Chemical variables of samples (pH, organic acids, trace metals, cellulose/lignin ratios) and environmental variables (moisture, temperature) will be made for the same locations and depths to relate chemical/environmental variables to gas production and microbial populations. Project work was initiated in FY 1986 with a survey of field sampling and laboratory culturing techniques. In addition, a pre-pilot investigation was initiated to suggest whether field sampling of liquid leachate (as a mixing medium) is sufficient or whether direct sampling of solid substrate is necessary to encounter large, viable populations of methanogens. Selected leachate samples were subjected to chemical analysis (COD, volatile acids, pH, alkalinity), incubated without additions for BMP testing, and microscopically examined using fluorescence techniques.

21147 (DOE/CH/10093—6, pp 140-141) **Variations in gas pressure and concentration gradients in landfill cover materials.** Bogner, J.E. (Argonne National Lab., IL). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

Vertical pressure gradients in the landfill cover and top of refuse plus vertical concentration gradients for methane, carbon dioxide, oxygen, and nitrogen are being investigated during changing meteorological and soil moisture conditions. The vertical gradient method permits statistical relationships between variables to be developed; this method also permits calculation of pressure and diffusional flow using Darcy's Law and Fick's First Law. Nests of probes at various depths at a variety of locations at the Mallard North Landfill site were designed to give replication within each nest and between nests. A field microcomputer permits continuous weather and soil gas pressure data to be acquired; frequent measurements of soil gas concentrations, soil moisture, and soil temperature are taken to examine both diurnal and seasonal changes. Besides statistical analysis of resulting data, a one-dimensional finite difference formulation to examine pressure and diffusional flow through landfill covers has been developed to aid data analysis. Unique types of equipment or instrumentation developed specifically for this project include (1) specialized probe design to facilitate both soil gas sampling and pressure monitoring at a single location and (2) customized microcomputer interface to weather station sensors and electronic pressure transducers for unattended continuous acquisition of meteorological and soil gas pressure data. A field gas chromatograph was thoroughly tested for reliability and sensitivity. Both short-term (diurnal) and longer term (seasonal) monitoring of soil gas pressure and concentration gradients was completed during calendar 1985 and 1986. Barometric pressure and soil moisture/temperature conditions strongly influence pressure and concentration gradients in landfill cover materials.

21148 (DOE/CH/10093—6, pp 142-143) **Bioconversion of MSW and recovery of short-chain acids for liquid fuels production.** Antonopoulos, A. (Argonne National Lab., IL). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

The objective of this work is to investigate the feasibility of using municipal solid waste (MSW) feedstock to first produce short-chain organic acids and then recover these acids and transform them to hydrocarbon fuels. Feedstock for anaerobic digestion is first processed to organic acids and finally to methane and carbon dioxide. Therefore, efforts are focusing on terminating the process of methanogenesis at the step of organic acids, and then on recovering these acids and further using them to produce hydrocarbon liquid fuels. Research showed that volatile acid concentrations near 10,000 mg/L can be maintained in an anaerobic digester operating on an 8-day solid and liquid retention time, using an MSW feedstock containing no protein. Increasing the protein content of the feedstock to 2% results in increased volatile acid production and accumulation. Work continues on methods to increase the yields and rate of acid production in anaerobic digesters. Efforts have been made to extract and recover the acids from the effluent liquid from the digesters.

21149 (DOE/CH/10093—6, pp 144-145) **Effluent dewatering research.** Chauhan, S.P. (Battelle Columbus Lab., OH). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

The Battelle electroacoustic dewatering technique (EAD) process that has been used to effectively dewater industrial sludge was selected in a competitive procurement to be one of the two processes to offer the best potential for the low energy dewatering of sludge to a fuel quality product that could be used in waste water treatment plants with less than 10 million gallons per day capacity. The evaluation of this process was conducted in three phases, namely: (1) conduct static tests to determine dewaterability of anaerobic digester sludge under combined effects of an acoustic field and an electric field of the magnitudes characteristics of the EAD process; (2) conduct in-depth study on the effect of variation in key sludge properties on EAD process performance; and (3) conduct dynamic process tests to verify static test data. Prior year work in Phase I developed the time, voltage, and acoustic power levels appropriate for practical performance with anaerobically digested sewage sludge. It was determined that a 50 volt field, 30 minute treatment with the 20 Hz acoustic field applied for the last 25% of the dewatering cycle achieved the optimum dryness of 37% to 39% solids in fresh sludge. But significant reduction in dryness was also observed in stored sludge. During FY 1986, Phase II investigated various chemical and physical properties of the sludge and found the EAD process performance correlated closely with the Zeta potential. Further research showed that the value of the Zeta potential could be used as an indicator of how well the sludge would perform in the EAD process. The corollary to this is that to improve dewaterability, the negative value of the Zeta potential must be increased. Albeit the 37% to 39% solid sludge is already autogenous and further reduction in moisture may not be necessary in sludges with high heating values.

21150 (DOE/CH/10093—6, pp 146-147) **High-solids digestion of MSW to methane.** Clausen, E.C.; Gaddy, J.L. (Univ. of Arkansas, Fayetteville). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

The objectives of this work are to determine (1) the feasibility of high-solids digestion of municipal solid waste (MSW) for enhanced methane production without impairing reaction kinetics and (2) the maximum solids concentration of MSW digested possible as a function of retention time. This work involves studies of appropriate methods to add concentrated MSW material in the anaerobic digesters and determining the minimum residence time for high-solids concentrations. Efforts are focusing mainly on utilizing high-solids MSW loading techniques, in combination with low retention times and cell recycle, to reduce the digester volume and increase methane yields. Results have shown that feeding high-solids concentrations can reduce digester size by as much as 67% while maintaining the same retention times and reaction rates. Digesters were fed with 10% to 30% solids and operated on a 10-to-60 day retention time schedule. The reactors were performing steadily at a level near the expected with a gas production performance rating from

71% to 95%. Up to 30% solids (feed) of MSW by a technique of separately feeding solids and liquids was achieved.

21151 (DOE/CH/10093—6, pp 148-149) **Effluent dewatering research.** Keinath, T. (Clemson Univ., SC). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

The objective of this project is to develop the low-temperature, low-pressure contact dryer and the heat pump drying cycle from an engineering concept into a practical and workable system for the drying of sewage sludge (and other types of sludge) into a fuel quality product. It is also the objective of this research to determine the practical limits of dryness required for efficient combustion and recovery of energy from the dried sludge. Prior year work in Phase I developed the necessary proof-of-drying process concept and demonstrated that this process could circumvent the problems of balling and stickiness in other processes. It also identified key factors and conditions for separation and removal of moisture from solid in the sludge. Phase II, conducted in FY 1986, demonstrated the ability of the contact dryer to handle several types of sludge and to achieve 50% solids with no more energy than normally used to dewater sludge to 15%-20% solids.

21152 (DOE/CH/10093—6, pp 150-151) **Digester gas production enhancement research.** Speece, R.E. (Drexel Univ., Philadelphia, PA). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

The objective of this project is to develop a better understanding of the effects of key nutrients and supplements and their ability to make an anaerobic digester a highly reliable device for high efficiency conversion of sludge into methane gas at lowest cost. Three tasks have been defined for the accomplishment of the project objectives: (1) research into factors determining anaerobic digester performance, (2) development of methods for improvement of digester performance, and (3) research the effects on and development of parameters for high performance under high solids concentration operation (i.e., 6%-8% solids). Studies to date have indicated a key role of iron, nickel, either vitamin B-12 or yeast extract, and the enzyme HSCoM in achieving acetate utilization rates of 10 to 15 times those normally achieved in operating digesters, leading to the potential for much higher methane production and shorter solids retention time. This higher performance offers the possibility for processing larger amounts of sludge and achieving higher gas production in existing waste water treatment plant digesters at a cost of less than 10% of the value of the gas produced.

21153 (DOE/CH/10093—6, pp 154) **Pretreated high-solids MSW for anaerobic digestion to methane.** Tsao, T. (Purdue Research Foundation, West Lafayette, IN). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

A novel process for treating and digesting high-solids municipal solid waste (MSW) for rapid methane generation was designed. This process enhances the solubilization of the cellulosics in MSW by applying cooking with lime in which the solids are solubilized in a very short time. After precipitation of calcium with recycled carbon dioxide, the cooked liquor is fed to a column anaerobic digester packed with immobilized bacterial cells to complete the methane generation. The calcium precipitation removes the excess carbon dioxide from the gaseous output and makes high-Btu methane gas. The use of a continuous extruder for the alkali-cooking pretreatment of MSW feedstock is under experimentation.

21154 (DOE/CH/10093—6, pp 157-158) **Effects of trace metals on methanogenesis and control of sulfate-reducing bacteria.** McKinney, R.E. (Univ. of Kansas, Lawrence). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

The objective of this work is to examine a way to develop improved microbial populations for the anaerobic digestion of municipal solid waste (MSW) through a better understanding of the need for specific trace metals and the use of heavy metals in controlling sulfate-reducing bacteria. Research efforts are focusing on the determination of needs for trace metals by bacteria involved in anaerobic digestion of MSW to methane, and on the effect of iron, chromium, and molybdenum on sulfate-reducing bacteria and methane production rates. Results of this study confirmed that trace metals are essential for optimum metabolism and maximum rate of organics stabilization in anaerobic digesters, and determined that iron, nickel, cobalt, molybdenum, manganese, zinc, and copper stimulate the bacteria in the metabolism of acids. The optimum trace-metal concentration was 0.1 mg/l, with stimulation at 0.01 and 1.0 mg/l concentrations. Excess sulfides precipitate the heavy metals and prevent them from being toxic. Studies on the trace metals resulted in the development of a simple, rapid screening technique. Another significant finding from this work was the failure to control sulfate-reducing bacteria with the addition of molybdenum, in contrast to literature reports. Molybdate proved to be toxic to both sulfate-reducing bacteria and to methanobacteria. Iron was shown to be useful in precipitating ferrous sulfides, but it had no effect on sulfate-reducing bacteria.

21155 (DOE/CH/10093—6, pp 159-160) **Development of high solids anaerobic digestion reactors for use in methane production from municipal wastes.** Wyman, C. (Solar Energy Research Institute, Golden, CO). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

The objectives of this project are to determine the operability of novel reactor designs for anaerobic digestion of high solids concentration of municipal solid waste (MSW) to methane, study the effect of key variables for the novel reactors on anaerobic digestion of MSW to methane, and initiate optimization of the design of the novel reactor system to improve yields and rates of conversion. Two reactors are being studied. In the first, the reactor is a cylindrical vessel positioned with a horizontal axis. The effect of different rotational speeds on digestion rates will be measured, and the power requirements for mixing will be estimated. As a second approach, a variation on the above reactor will be studied. This device will be beneficial if the power required to operate the continuous blade device proves excessive. Once again, the effect of rotational speed on digestion rates will be investigated.

21156 (DOE/CH/10093—6, pp 161-162) **Extracellular hydrolytic enzymes from anaerobic digestion effluent treating municipal solid wastes.** Himmel, M. (Solar Energy Research Institute, Golden, CO). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

The objective of this project is to develop or adapt assay techniques for the most important hydrolytic enzymes (cellulases, hemicellulases, amylases, proteses, and lipases) both free in the cultures and bound to the substrates. In addition, optimal levels of each enzymatic activity will be determined. Two approaches will be tested. In the first approach, SERI researchers will attempt to quantitatively elute the hydrolytic activities from the substrate by pH and/or temperature swings or by application of mild protein denaturing agents. In the second approach, researchers will develop methods for selective poisoning of microorganisms in the anaerobic digester without affecting the specific activity of hydrolytic enzymes. The poisoned cells will not be able to take up the monomeric and oligomeric products of hydrolytic enzymes, which will remain in solution and become measurable by analytical techniques developed in the first phase of the project. The methods will be quantified by adding known amounts of specific hydrolytic activities to an anaerobic digester and measuring the recovery of these activities. The methods using the first or the second approach will be standardized and published. The optimal levels of each hydrolytic activity will then be determined by adding the known amounts of each particular hydrolytic enzyme to the municipal solid waste substrate and determining the kinetic parameters for substrate hydrolysis.

21157 (DOE/CH/10093—6, pp 163-164) **Optimization of two-stage anaerobic digestion of MSW by reduction-oxidation (redox) potential.** Grohmann, K. (Solar Energy Research Institute, Golden, CO). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

The objectives of this project are to (1) establish data on the rates and extent of hydrolysis of lignocellulosic materials in municipal solid waste (MSW) (cellulose and newspaper) under aerobic, microaerophilic, and strictly anaerobic conditions; (2) optimize conditions for degradation of lignocellulosic biomass coupled to production of short-chain fatty acids by adjustments of oxygen tension in the first stage; and (3) demonstrate coupling of a first- and second-stage digester system. The range of microaerophilic conditions in which MSW is converted to organic acids will be established by decreasing the reduction/oxidation potential of the cultures in steps from fully aerobic conditions to fully anaerobic ones, and measuring organic acids in digester effluents. The range of redox potentials in which organic acids are not oxidized by microorganisms will be determined by increasing the reduction/oxidation potential of cultures fed organic acids from anaerobic to aerobic conditions in steps. The disappearance of organic acids will be monitored by chromatographic techniques. Data will be evaluated and compared to the results from aerobic and anaerobic operation.

21158 (DOE/CH/10093—6, pp 165-166) **Photoenhanced stability and rates of anaerobic digestion.** Weaver, P. (Solar Energy Research Institute, Golden, CO). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

The objectives of the research are to maximize the rates and extents of the biological conversion of fatty acids found in anaerobic digesters into hydrogen and carbon dioxide, which are the optimal precursor substrates of methane. Success in this project should lead to enhanced methane production in anaerobic digesters and increased stability of the digesters at high loading rates. The research approach involves investigating and optimizing the natural association of photosynthetic bacteria (and low levels of solar energy) with methanogenic bacteria. Photosynthetic bacterial strains that exhibit high rates of hydrogen production from fatty acids (particularly from propionic, butyric, and acetic acids) will be selected. The metabolic mechanisms by which this occurs, the conditions for maximal expression, and the rate-limiting steps will be determined. Optimal and minimal light-energy requirements will be established using light/dark cycles that mimic the light availability for stirred-tank digesters. Digesters incorporating photosynthetic bacteria that are fed defined and natural substrates will be analyzed for rates of methane production and extents of substrate removal.

21159 (DOE/CH/10093—6, pp 171-172) **Flash pyrolysis of biomass in reactive atmospheres.** Steinberg, M. (Brookhaven National Lab., Upton, NY). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

The flash pyrolysis of wood chips is being determined in a 2.54 cm I.D. downflow entrained tubular reactor. The reactive pyrolyzing gases being investigated include H_2, CH_4, CO_2, and CO; the non-reactive gases are He, Ar, and N_2. The gaseous products formed, which include CH_4, C_2H_6, C_2H_4, C_3H_8, BTX (benzene, toluene, xylene), CO_2, and CO, are determined with an on-line process gas chromatograph, and the heavier carbonaceous oils and liquids are collected over the entire run for a mass balance. The product yields are correlated as a function of the parameters of pressure, temperature, and residence time. For the hydropyrolysis of Douglas fir, in which hydrogen is used as the pyrolyzing gas at temperatures of 900° to 1000°C, 3.5 MPa pressure, and <1 sec particle residence time, the main products are methane and water. At higher residence times $>$ 3 sec, the products are methane and CO, and yields exceeding 90% carbon conversion. Processes based on these data indicate an economic potential for the production of SNG and methanol. The flash pyrolysis with methane gas (flash methanolysis) leads to high yields of ethylene, benzene, and CO. Using pine wood chips at reactor conditions of 900° to 1000°C, 0.35 MPa and 1 sec residence time, the ethylene yield increases to 27%, the benzene to 25%, and the CO to 39%, which constitutes more than 90% of the carbon in pine-converted, high-value products. In comparison with the inert gases N_2 and He, the yield of ethylene with methane is up to 2.5 times that obtained with inert helium at 1000°C. Preliminary process design and analyses indicate an economically competitive system for the production of ethylene, benzene, and methanol by the flash methanolysis of wood.

21160 (DOE/CH/10093—6, pp 173-174) **Research on the pyrolysis of hardwood in an entrained bed process development unit.** Kovac, R.J. (Georgia Institute of Technology, Atlanta). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

The objectives of this project are to design and construct an entrained flow pyrolysis process research unit (PRU), and to conduct an experimental program on the entrained flow pyrolysis of biomass (hardwood) to determine the process conditions for optimization of oil yields and to obtain basic engineering data on the entrained pyrolysis process. A 125 lb/h entrained bed PRU was designed and constructed. The PRU performed satisfactorily during a series of preliminary tests. Experiments at temperatures between 400° and 525°C with 40 x 50 and 50 x 60 mesh oak feedstock have been conducted. The results demonstrated that oil yields (wt basis) greater than 50% based on moisture-ash-free wood could be obtained. An empirical model based on the experiments was developed to relate the oil yield to reactor temperature and residence time. This model suggests that yields as high as 60% are possible in the PRU.

21161 (DOE/CH/10093—6, pp 175-176) **Development of biomass gasification to produce substitute fuels.** Babu, S.P. (Institute of Gas Technology, Chicago, IL). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

The objective of this project is to develop an efficient pressurized, oxygen-blown, fluidized-bed gasification process to produce medium-Btu fuel gas or synthesis gas from biomass. Five tasks were defined to accomplish the project objective: (1) Characterization of Biomass, (2) Biomass Handling Characteristics, (3) Bench-Scale Experiments, (4) Process Research Unit (PRU) Tests, and (5) Data Review for Process Scale-Up and Economic Assessment. The results obtained from the first three tasks were used to design and construct a 12-in. diameter fluidized bed gasifier PRU. Experiments have been conducted in the PRU at pressure up to 345 psig and through puts up to 925 lb/h (moisture-free basis). These experiments have evaluated the effects of temperature, pressure, wood, steam feed rates, moisture, bed height, and feedstock type on gasifier performance and gas yield and quality. A three-day continuous test was also completed to evaluate long-term effects on gasifier performance.

21162 (DOE/CH/10093—6, pp 177-178) **Liquid hydrocarbon fuels from biomass.** Elliott, D.C. (Pacific Northwest Lab., Richland, WA). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW. Contract AC06-76RL01830.

In Biofuels and municipal waste technology research program summary: FY 1986.

High-quality hydrocarbon fuels can be produced from biomass through direct liquefaction and product upgrading by hydrodeoxygenation. Optimization of the hydrodeoxygenation is of interest worldwide. International coordination of direct liquefaction process research is the focal point of this research effort. Preliminary experiments with hydrotreating catalysts have shown that gasoline-like hydrocarbons can be produced from a variety of biocrude oils. Several parameters have been identified for study in the continuous-feed reactor system.

21163 (DOE/CH/10093—6, pp 179-180) **Analysis of medium-Btu gasifier organic products.** Elliott, D.C. (Pacific Northwest Lab., Richland, WA). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW. Contract AC06-76RL01830.

In Biofuels and municipal waste technology research program summary: FY 1986.

The by-product tars from biomass gasification have received little study in the past as to their chemical composition and physical handling properties. As biomass gasification to produce medium-Btu gas makes the transition from research and development to demonstration and commercialization, complete mass balances must be attained and by-product disposal techniques determined. As a result, a detailed analysis of the tar/condensate properties must be undertaken. The objective of this project is to undertake in-depth analysis of the tar products and by-products produced by medium-Btu gasification of biomass. A detailed report will be produced describing the products from each of the four gasification processes sponsored by the Biomass Thermochemical Conversion Program.

21164 (DOE/CH/10093—6, pp 181-182) **Thermal treatment to reduce tars in biomass-derived gases.** Mudge, L.K. (Pacific Northwest Lab., Richland, WA). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW. Contract AC06-76RL01830.

In Biofuels and municipal waste technology research program summary: FY 1986.

The primary objective of this project is to develop methods for thermally eliminating organic liquids from biomass-derived-fuel gases using catalysts. A bench-scale fluidized bed gasifier was operated to obtain baseline data on the effect of temperature and the contact gas on the yield and composition of organic liquids in the product gas. A second reactor would be placed downstream from the gasifier, and experiments using the combined system would be performed to evaluate catalysts. The bench-scale gasifier was operated over a temperature range of 650° to 800°C using CO_2, CH_4, H_2, H_2O, and an H_2O/air mixture as the contacting gas. Organic liquids were collected and analyzed for yield and composition.

21165 (DOE/CH/10093—6, pp 183-184) **Low-temperature thermochemical conversion of high-moisture biomass feedstocks to high value fuels.** Sealock, L.J. Jr. (Pacific Northwest Lab., Richland, WA). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW. Contract AC06-76RL01830.

In Biofuels and municipal waste technology research program summary: FY 1986.

The objective of this project is to investigate the chemistry and feasibility of the low-temperature catalyzed conversion of biomass-water slurries in a pressurized reactor. Seven tasks are being investigated to accomplish the objectives of the project: (1) procurement and characterization of high-moisture biomass feedstocks, (2) design and installation of the experimental system, (3) feedstock screening tests, (4) batch kinetics development, (5) determination of the effects of biomass to water ratios, (6) continuous-mode experiments, and (7) concept evaluation. Nine high-moisture biomass feedstocks have been obtained and characterized. Assembly of a 1.0 liter, high-pressure reactor system and associated equipment has been completed. Preliminary experiments have been performed to provide baseline data required to measure the effectiveness of the alkali/nickel catalyst system. Carbon conversions and methane yields obtained using several of the feedstocks are encouraging, and in some cases exceed those obtained via anaerobic digestion. Early batch kinetics studies indicate that the residence time required to fully convert the feedstocks is relatively short (on the order of 10-15 minutes at 370°-400°C).

21166 (DOE/CH/10093—6, pp 185-186) **Technical and economic assessment of emerging biomass thermochemical conversion technologies.** Wan, E.I. (Science Applications, McLean, VA). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

Four tasks have been defined to accomplish the project objectives: (1) analysis of the performance of new and advanced biomass thermochemical conversion processes including combustion, gasification, pyrolysis, and liquid fuel synthesis technologies; (2) development of conceptual designs for biomass-to-fuel processes using process models; (3) performance of process parametric and economic sensitivity analysis; and (4) identification of further research needs for exploiting new technology to convert biomass to high-value fuels. Studies to date have assessed the available technical data of several innovative combustion, gasification, pyrolysis, and liquid fuel synthesis processes being developed to produce electricity, medium-Btu gas, synthetic natural gas, and liquid fuels from biomass. These processes offer potential to produce products with considerable economic value.

21167 (DOE/CH/10093—6, pp 187-188) **Studies of rapid pyrolysis of biomass and upgrading of pyrolysis vapors.** Milne, T.A. (Solar Energy Research Institute, Golden, CO). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

The objective of this research is to demonstrate the feasibility of using zeolite catalysts (such as ZSM-5) to upgrade primary pyrolysis vapors from wood. The resulting hydrocarbon slate would serve directly as gasoline, a gasoline extender, or an octane enhancer. Two levels of experimentation are under way. In the first, wood vapor and model compounds are passed over small quantities of zeolite catalyst in a pulsed or steady-state quartz microreactor. The products are sampled directly, and in real time, with SERI's molecular-beam, mass-spectrometric high-pressure sampling system. This system permits identification of the complex vapors actually being fed to the catalyst. All vapor phase products but H_2 can be observed simultaneously. The second level of study is with SERI's entrained-flow, vortex reactor. In this system, high wood-vapor compositions can be achieved, behavior of the catalyst bed can be monitored, and products can be collected to close mass balances. In FY 1986, the effort was concentrated on screening results, obtained with a sample of ZSM-5 supplied in a cooperative agreement with the Mobil Corporation. Wood vapor, model compounds, and methanol were studied. Initial results indicate that fresh ZSM-5, in pellet form, converts the primary vapors from wood to an entirely new product slate plus a not-yet-quantified amount of coke. The shape-selectivity is manifested in an aromatic liquid-hydrocarbon slate, which is predicted to have very high blending octane numbers.

21168 (DOE/CH/10093—6, pp 189) **Operation of a pressurized downdraft gasifier to produce medium-Btu gas.** Reed, T.B. (Solar Energy Research Institute, Golden, CO). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

The objective of this project is to obtain performance data from a 30-in. diameter gasifier based on the stratified downdraft gasifier concept to evaluate the technical feasibility of the concept. A series of experiments were conducted to evaluate the effects of wood species, moisture content, and wood feed rate on gasifier performance. Wood feed rates of up to 2000 lb/h were obtained using the system. A 100-h continuous test was also conducted to evaluate long-term effects on gasifier operations.

21169 (DOE/CH/10093—6, pp 190-191) **Advanced biomass direct liquefaction extruder-feeder reactor systems.** White, D.H. (Univ. of Arizona, Tucson). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

This project is to construct and operate experimentally a laboratory, continuous, biomass liquefaction unit, based on advanced technology developed for the extruder-feeder for feeding pressure systems. The unit would provide a biocrude oil product suitable for subsequent upgrading into hydrocarbon fuels. The liquefaction unit was operated under a variety of experimental conditions for continuous periods of up to 52 hours. The reactor operated smoothly without plugging or internal carbon formation. The preliminary data indicate it may be possible to significantly lower the operating pressure and to reduce or eliminate the carbon monoxide reducing gas. Both factors should lead to improved process economics.

21170 (DOE/CH/10093—6, pp 192) **Steam gasification of wood in a fluidized bed using indirect heating with fire tubes.** Flanigan, V.J. (Univ. of Missouri, Columbia). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

The primary objective of this project is to determine the technical and economic feasibility of using a fire-tube heat exchanger to provide heat to a fluidized bed gasifier for the production of medium-Btu gas. The 20-in diameter reactor has operated with feed rates up to 200 kg/h and bed temperatures up to 820°C. Experiments investigating temperature, steam rate, and feed rate have been completed. A five-day continuous test was conducted to obtain longer term operating data. Experiments to evaluate feeder locations were also completed. Experiments using product gas recycle to fluidize the bed have yet to be completed.

21171 (DOE/CH/10093—6, pp 193) **Ablative pyrolysis.** Reed, T. (Colorado School of Mines, Golden). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

The objectives of this project are to test the design and operation of a pyrolysis mill, test the mass and energy balance for pyrolysis milling, and produce sample quantities of pyrolysis oils from various biomass feedstocks, including refuse-derived fuel (RDF), for analysis. In FY 1986 the author will build a contact pyrolysis mill to produce raw pyrolysis oil from municipal solid waste in high yield, with tolerance for heterogeneity and ash due to the mechanical wiping pressure. The ability to inject steam or other gases will be explored. Particles will be pressed between two heated plates rotating relative to each other. As vapors form, they immediately will be swept out of the hot zone by the volume increase of vapor. Ash will be comminuted and moved to an outer collection zone. Once generated, the vapor can be collected as a boiler fuel, catalytically converted to high-grade liquid fuels, or cracked at a higher temperature to medium-Btu gas. The device will be operated at temperatures of 500° to 600°C using a mill-like action to pyrolyze/grind the particles between metal plates.

21172 (DOE/CH/10093—6, pp 194) **Catalytic pyrolysis research.** Helt, J.E. (Argonne National Lab., IL). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

The objective of this project is to add to the data base for future technologies associated with the conversions of municipal solid waste (MSW) to liquid fuels that can be developed by private industry when determined by the marketplace. This task explores the possibility of using catalytic hydrotreating to upgrade the liquid products produced during conventional pyrolysis of MSW to liquid fuels with higher value and stability. The liquid products obtained from MSW pyrolysis processes are generally unsuitable for use as liquid fuels. Heating values are low, and the liquids are very corrosive, viscous, and unstable during storage. A major reason for these problems is the extremely high oxygen content of the pyrolysis products. The kinetics of catalytic reactions that remove oxygen-containing compounds from the pyrolysis liquids is being experimentally determined in a high-pressure, fixed-bed microreactor of the trickle-bed type. The reactions of interest involve the reduction of the oxygen-containing hydrocarbons with high-pressure hydrogen using a solid catalyst. The catalysts that have been used are primarily commercially available hydrodesulfurization catalysts containing molybdenum oxide with either cobalt or nickel oxide, supported on a high-surface-area alumina matrix. A few exploratory runs have also been made using a zeolite catalyst.

21173 (DOE/CH/10093—6, pp 198-199) **Basic mechanisms of pyrolysis of municipal solid waste.** Helt, J.E. (Argonne National Lab., IL). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

The objective of this project is to create a data base for future technologies associated with the conversion of municipal solid waste (MSW) to liquid and gaseous fuels that can be developed by private industry when determined by the marketplace. Expansion of the data base will result in a better understanding of the thermokinetic mechanisms associated with the pyrolysis of MSW. This work will attempt to (1) define the primary and secondary chemical reactions involved in the pyrolysis, (2) identify the important operating parameters and how they influence the reactions, and (3) produce a useful kinetic model. At ANL, data collection in the low-temperature range (< 500°C) has continued with the benchscale reactor. Both single and multicomponent samples were pyrolyzed over a variety of operating conditions to permit the qualitative and quantitative analyses of the product liquids and gases. High-temperature (gasification) studies have been started on single components. In both the high- and low-temperature ranges, product distributions, product quality, and the effects of operating parameters are being determined.

21174 (DOE/CH/10093—6, pp 205-206) **Mechanisms of the pyrolysis of municipal solid waste.** Milne, T.A. (Solar Energy Research Institute, Golden, CO). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

The objectives of this project are to (1) develop a rapid method of characterizing the liquid products from pyrolysis based on mass spectrometric data and (2) expand the data base on the low-temperature municipal solid waste pyrolysis to oils. This work is equally divided among three subtasks. These subtasks are, in part, a continuation of the ongoing effort to develop a rapid method of oil characterization via compound class analysis. These three subtasks are (1) compound class analysis by advanced pattern recognition techniques, (2) liquid product analysis via compound class analysis, and (3) development of the relationship of chemical composition to fuel properties. Also, experimental studies will be performed on the solid-phase and gas-phase processes of low-temperature pyrolysis. Work has begun on a method for rapid determination of oil composition and the relationship to the physical and chemical properties of the oil that determine its use as a fuel. Systems for Interactive Graphics-Oriented Multivariate Analysis (SIGMA), a fully interactive, user-friendly, multivariate analysis program, has been implemented, and some trial data sets have been processed to test the data translation process. Ongoing work also includes continuation of a parametric study focused on the development of a quantitative data base for the low-temperature regime of 300° to 500°C and for residence times up to several seconds.

21175 (DOE/CH/10093—6, pp 207) **Fundamentals of direct liquefaction of solid waste in a semicontinuous microprocessor-controlled autoclave.** White, D.H. (Univ. of Arizona, Tucson). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

The objectives of this task were to (1) define the role of the water-gas shift reaction in the liquefaction of municipal solid waste (MSW) and (2) ascertain mechanisms of the chemical reactions that occur during the liquefaction of MSW. The approach was to perform high-pressure autoclave experiments to study the fundamental chemistry of the direct liquefaction of MSW. Various components of MSW were studied in order to obtain meaningful data, not confused by the different thermokinetics of more than one distinct MSW component. Feedstocks included wood, flour, cardboard, newsprint, and rice (starch), as well as the important model compounds α-cellulose and lignin. The University of Arizona completed its experiments on the direct liquefaction of MSW to oils. It was found that the MSW components could be converted to liquid oils and a high-heating value residual solid at temperatures of 325° to 400°C and pressures of 1000 to 3000 psi. This is a temperature level about 100°C lower than that required for coal liquefaction.

21176 (DOE/CH/10093—6, pp 215-216) **Alaska-AVEC biomass gasifier.** Marks, J.A. (Marenco, Inc., Anchorage, AK). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

The objective of this project was to demonstrate the feasibility of a simple, reliable wood gasification-power generation system for use in remote Alaskan villages. The integrated system was to include wood gathering, transportation, processing, utilization, and waste disposal using local village labor and fuel resources. In 1980, Marenco, Inc., developed a 100-kW gasifier for use in these remote areas. Initial testing revealed problems with wood drying, wood and ash handling, gas cleaning and cooling, and lack of automation. However, overall testing of the 100-kW system indicated the project was technically feasible. These efforts led to the design and fabrication of a larger 250-kW prototype unit for testing in an industrial environment. An equipment review and system evaluation was conducted on the prototype downdraft gasifier and engine generator unit, a 48-in. Marenco unit. Serious questions were raised about the design, work quality, and operating history of the unit. The review team concluded that the system was inadequate to perform on a full-load, uninterrupted basis. The decision was made to dismantle the equipment in Alaska and ship it to SERI for further testing and development work or use in other projects. During the dismantling operation, a potentially hazardous gasifier waste stream was discovered in the prototype scrubber. Additional amounts of waste were uncovered in holding tanks in and outside the warehouse facility. Precautionary and investigative measures were immediately taken. Activities have been performed to restore the area and determine any potential environmental impacts. Beyond general site clean-up work, the activities have included soil coring, well testing, and an array of laboratory analyses. No ground water or residual contamination was indicated.

21177 **(DOE/PC/80016—T6) Improved Fischer-Tropsch synthesis catalysts for indirect coal liquefaction: Quarterly technical progress report No. 7, 1 April 1987-30 June 1987.** Tong, G.T.; Wilson, R.B.; McCarty, J.G. (SRI International, Menlo Park, CA (USA)). 1987. Contract AC22-85PC80016. 16p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005671/JAW.

Three monomeric supported ruthenium catalysts were evaluated for Fischer-Tropsch performance with 1:1 H_2:CO synthesis gas at 1 atm. This effort completes the FTS evaluation of a series of nine supported multiatomic and atomic ruthenium catalysts prepared via organometallic reactions of tetra- and hexaruthenium hydridocarbonyls and allyl monoruthenium carbonyl complexes with acid sites on three support materials, alumina, sodium Y zeolite, and molecular sieve. The product distribution of the three monomer catalysts was remarkably dependent on the nature of the support. The ruthenium catalyst supported on sodium Y zeolite had superior FTS performance relative to a conventionally prepared alumina-supported ruthenium catalyst during a 24-h run at 523 K with 1:1 H_2:CO synthesis gas at 1 atm. Its chain growth factor was higher (0.57 vs 0.47), methane selectivity lower (45 wt % vs 58 wt %), and olefin-to-paraffin ratio for light hydrocarbons higher (2.2 vs 1.3). The FTS results for the molecular sieve catalyst under the same reaction conditions were inferior with low chain growth parameter (0.23) and high methane selectivity (77 wt %). The C/sub 2+/ hydrocarbon synthesis rates of all the ruthenium catalysts were comparable. The effect of high-level sulfur chemisorption on the FTS performance of alumina-supported cobalt was also examined. 4 figs., 3 tabs.

21178 **(DOE/PC/90009—3) Evaluation of direct methane conversion to higher hydrocarbons and oxygenates: Final report.** Kuo, J.C.W. (Mobil Research and Development Corp., Paulsboro, NJ (USA)). Aug 1987. Contract AC22-86PC90009. 218p. NTIS, PC A10/MF A01; 1; GPO Dep. Order Number DE88003812/JAW.

This report describes evaluation studies on processes that directly convert methane to higher hydrocarbons and oxygenates (without formation of H_2 and CO as intermediates). The direct methane conversion processes were first screened through preliminary evaluations, including thermochemical calculations, some scoping calculations of the thermal and carbon efficiencies, and summary of the advantages, disadvantages, and recommendations of each direct conversion process. Two processes were then selected for more detailed evaluation. As a standard of process comparison, two cases of a conventional Natural Gas-to-Methanol via Steam Reforming process were established. The detailed evaluation included designs of a base case and several sensitivity cases, heat and material balance calculations, and calculations of the thermal and carbon efficiencies and the process duties (the heat transfer, and gas compression and expansion). With high methanol selectivities (>80%) and reasonable conversions (>7.5%), the Direct Partial Oxidation route was far superior to the standard indirect conversion route, particularly in the heat transfer duties. The process scheme was simple because of simple products and easy product separation. Recommendations for future work are given, including a thorough evaluation of the potential advantages of emerging indirect conversion technologies. 200 refs., 8 figs., 52 tabs.

21179 **(ETSU-L—22) Landfill gas - a global review.** Richards, K.M. (UKAEA Harwell Lab. Energy Technology Div.). Aug 1987. 42p. (CONF-8709238—). British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

From 7. international biodeterioration symposium; Cambridge, UK (8 Sep 1987).

A worldwide survey of landfill gas recovery and utilisation facilities shows there to be at least 146 commercial schemes currently in operation in a total of fifteen countries, with a further 32 trials underway. At a very conservative estimate these projects are saving 825,000 tcepa by replacing sources of more conventional, non-renewable energy. Some 77% of these projects (137 in total) are situated in the United States, West Germany or the United Kingdom. Of the remainder all but four schemes are located in either Western Europe or Canada. The preferred routes to energy exploitation are through the generation of electricity using engines (56 schemes) a total of more than 170 MW capacity, burning in boilers (33 schemes, kilns/furnaces (15 schemes) or purification for main pipeline distribution or use as a vehicle fuel (13 schemes).

21180 **(PB—88-159918/XAB) Nature of methane activation over oxide centers. Annual report, September 1986-September 1987.** Marcelin, G.; Agarwal, S.K. (Pittsburgh Univ., PA (USA). Dept. of Chemical Engineering). Oct 1987. 62p. NTIS, PC A04/MF A01.

The direct conversion of methane was studied using alkali-promoted antimony oxide as a catalyst. In accordance with the authors expectations, reasonable selectivities could be achieved for the transformation to ethane. Kinetic and mechanistic studies suggest that the formation of ethane occurs via free-radical coupling. The formation of CO(x), however, is more complex and occurs via various pathways, including: gas-phase reaction, surface-induced gas-phase reaction, and surface reaction. NMR and ionic conductivity studies have been used to try to elucidate the nature of the intermediates and the oxide center.

21181 **(PB—88-160098/XAB) Sorghums for methane production. Final report, April 1983 to March 1986.** Hiler, E.A.; Miller, F.R.; Dominy, R.E.; Kresovich, S.; McGee, R.E. (Texas Agricultural Experiment Station, College Station (USA)). Jun 1986. 272p. NTIS, PC A12/MF A01.

See also PB—86-132305.

The objective of the research is to develop an integrated system for methane production utilizing high-energy sorghum as the feedstock. The report provides specifics of research activities in the sorghums-for-methane production program sponsored by Gas Research Institute and co-funded by Texas Agricultural Experiment Station. Emphasis is placed on third-year results in the report since first- and second-year results are given in earlier reports. Researchers in the program include plant geneticists, sorghum physiologists, chemists, agronomists, ruminant physiologists, agricultural and systems engineers, and agricultural economists. Major research emphasis is on genetic manipulation, physiology and production systems, harvesting, storage, processing and conversion systems, inhibitors, and economic and systems analyses. During the third year, increasing emphasis continued on the storage, processing, and conversion aspects of the program because of the critical importance of high efficiency and conversion to the economic implementation of the system.

0902 Alcohol Fuels

REFER ALSO TO CITATION(S) 20759, 20764, 21159, 21267, 21916, 22967, 22968, 22969, 22970

21182 (DOE/CH/10093—6, pp 101-102) **Fusarium strain selection.** Antonopoulos, A.A. (Argonne National Lab., IL). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

The fungi Fusarium oxysporum has the ability to produce cellulase enzymes, which hydrolyze cellulose; produce lignin-degrading enzymes; and ferment both five carbon sugars such as xylose and six carbon sugars such as glucose to ethanol. The objective of this project is to determine if these abilities can be exploited to develop an efficient and cost-effective fermentation or hydrolysis process for converting lignocellulose to ethanol. The project has had several phases: (1) Isolation of Fusarium strains that delignify, hydrolyze, or ferment biomass to ethanol; (2) characterization of the cellulase and ligninase enzymes produced by the organism to better understand the potential of the organism; and (3) studies of the ability of the organism to ferment glucose and xylose to ethanol. The cellulase enzyme complex produced by Fusarium was shown to operate in the same manner as that of the better understood enzyme producer T. reesei, and several of the wild type Fusarium could produce the enzyme at rates similar to wild type Trichoderma. However, as there were no large advantages to cellulase production with Fusarium, it was decided that investment in strain improvement research should be carried out with the more highly developed Trichoderma species. Research is now focused on improving the ability of Fusarium to ferment xylose to ethanol. Yields and rates of these fermentations are equal to the best reported in yeast fermentations, but research is necessary to improve the maximum practical ethanol concentration, and to further improve the fermentation rates.

21183 (DOE/CH/10093—6, pp 103-104) **Fuels from lignins.** Chum, H.L.; Johnson, D.K. (Solar Energy Research Institute, Golden, CO). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

The objective of this project is the cost-effective conversion of lignins into methyl aryl ethers, which can be used as octane enhancers that are fully compatible with gasoline. At SERI specially developed catalysts prepared at CSM (Colorado School of Mines) with dual functionalities were tested. For these model compound tests, a special micro-trickle bed reactor was constructed, such that the authors can operate in the temperature and pressure regimes needed, and can collect gaseous and liquid samples to monitor the progress of the reaction. Gas chromatography/mass spectroscopy was employed to determine the nature of the products formed. Reaction products are then quantified using gas chromatography (FID detection) on capillary columns to allow separation of these various types of compounds. High-performance liquid chromatography is also employed. The authors also carried out tests on well characterized lignin samples, in a small-scale tube reactor which they operate at CSM and modified such that they could sweep the volatile products out of the reactor and condense them, thus avoiding secondary condensation reactions that occur if these phenolic compounds are left in the reactor in contact with reactive lignin fragments. Phenolic compounds yield improvement of a factor of 10 was observed on going from batch to batch with product sweeping operation. In addition, by using high-performance size exclusion chromatography they verified that the catalytic process employs only the small molecular weight lignins; thermal cracking precedes the catalytic process. Based on the results, it is imperative that volatile products are removed from the reactor as they are formed, and judicious thermal cracking of the samples to monomers might increase the yields of phenolic compounds.

21184 (DOE/CH/10093—6, pp 105) **Catalyst development.** Cowley, S. (Colorado School of Mines, Golden). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

The development of catalysts for processes that economically transform lignins into high-value liquid fuels requires the development of catalysts to convert lignins into phenolic compounds. Dual functionalities have been built into the catalysts, such as in the phosphoric acid impregnated nickel/molybdenum on alumina. The metal atoms are responsible for the hydrogenation/hydrodeoxygenation functions. The acidic support allows side-chain cracking to occur and modulates the extent of hydrodeoxygenation. The ability to combine all of the desired functions into a heterogeneous catalyst is tested by using well-defined lignin model compounds, such as 4-propylguaiacol. The catalysts are prepared and characterized at CSM (Colorado School of Mines), and the test of the catalysts with model compounds is performed at SERI. Families of catalysts are prepared in which the support acidity is varied systematically. Some of the catalysts prepared require sulfidation. Others will not require sulfidation, and therefore, depart from conventional petroleum- and coal-processing technologies. Several batches of catalyst have been prepared at CSM and transferred to SERI where performance is being evaluated.

21185 (DOE/CH/10093—6, pp 106-108) **Lignin characterization (previous task title: Lignin chemistry and electrochemistry).** Chum, H.L. (Solar Energy Research Institute, Golden, CO). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

During FY 1985 and FY 1986, lignins were evaluated for their application in high-volume polymeric applications and as a feedstock for high-value fuel octane enhancers. A number of applications were reviewed: currently used surfactants, the largest volume asphalt applications, providing substitutes for phenol in phenol-formaldehyde thermosetting resins and other adhesive systems, as a component of engineered plastics, as carbon black replacements, and as feedstock for fuels production. Market opportunities were reviewed in several categories, and measures of intensity of demand were made for the year 2000. The chemical characterization of lignins isolated from various pretreatments such as steam explosion and organosolv processes has been carried out for aspen. The isolation includes the extraction of the lignins from the pretreated lignocellulosic cake with such solvents as dilute sodium hydroxide or mixtures of aqueous and non-aqueous solvents. Organosolv lignins isolated from methanol/water solutions were also investigated. Chemical, functional, and spectroscopic analyses have been carried out on these lignins. Another important characterization parameter they investigated is the molecular weight distributions of these lignins by high performance size exclusion chromatography and complementary techniques.

21186 (DOE/CH/10093—6, pp 109-110) **Fermentation of xylose to ethanol.** Lastick, S.M. (Solar Energy Research Institute, Golden, CO). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

Many yeasts can ferment xylose to ethanol after the sugar is isomerized to xylulose, a conversion that requires the bacterial enzyme xylose isomerase. The approach taken in this project is to produce high levels of xylose isomerase by the genetic engineering of strains of the common bacteria E. coli and to use this enzyme to convert xylose to xylulose in the presence of xylulose-fermenting yeasts to produce ethanol. Since the isomerization reaction is reversible, with only 10% to 15% of the xylose converted to xylulose at equilibrium at fermentation temperatures (30°-37°C), a process configuration is used to continuously remove xylulose from the fermentation allowing for maximal isomerization rates and hence high rates of ethanol production. A DNA fragment containing the gene for xylose isomerase was isolated from a bacterium, E. coli, and then reintroduced into various strains of this bacterium using plasmid vectors that allow for massive production of the enzyme. This has been completely successful; it is estimated that as much as 40% of the total protein in the cells represents xylose isomerase, and equivalent overexpression has been obtained in all strains tested. This overproduced enzyme is highly active and the cells containing

the enzyme have been used to convert xylose to ethanol by a bench-scale process.

21187 (DOE/CH/10093—6, pp 111-112) **Integrated organosolv.** Chum, H.L. (Solar Energy Research Institute, Golden, CO). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

Organosolv pretreatments lead to cellulosic residues that are easily hydrolyzed by enzymes. A number of tests have been performed with lignocellulosic materials that were pretreated with methanol: water (varying methanol concentrations from 30% to 70% by volume) in the presence of acidic catalysts (sulfuric and phosphoric acids). Batch pretreatments have been carried out and found to produce digestible residues. In these pretreatments, there is a possibility of recondensation of lignins onto the fibers. Flow-through conditions are known to increase delignification rates by factors of 3 to 4. The objective of the task is to assess the effect of carrying out the organosolv pretreatment under flow conditions on the digestibility of the resulting cellulosic residues. This process could lead to higher yields of recoverable sugars and digestible carbohydrates. A small scale (150 g biomass) flow through reactor has been designed and constructed to carry out comparisons between batch and flow through delignification. The reactor has been tested and the investigation of catalysts continues.

21188 (DOE/CH/10093—6, pp 113-114) **Fuel ethanol technology evaluation.** Wright, J.D. (Solar Energy Research Institute, Golden, CO). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

The objectives of this project are to identify the research areas in feedstock production and the biochemical conversion of lignocellulose to ethanol, to quantify the performance of the various processes, and to evaluate the past progress and future potential of the various research areas. A multi-laboratory study was undertaken. SERI and Oak Ridge National Laboratories evaluated the cost and availability of waste conventional wood, agricultural residues, short-rotation woody crops, herbaceous energy crops, and municipal solid waste. SERI conducted evaluations of the major conversion processes, including: plug flow dilute acid; progressing batch dilute acid; concentrated sulfuric acid; liquid phase concentrated hydrochloric acid; liquid phase hydrofluoric acid; separate hydrolysis and fermentation w/steam explosion pretreatment, and organosolv pretreatment; simultaneous saccharification and fermentation (SSF); direct microbial conversion; xylose fermentation; and lignin conversion to methylanyl ethane. SERI and Argonne National Laboratory cooperated in evaluating the size and value of the potential markets for ethanol and its co-products. Finally, SERI integrated the study into a coherent whole. The woody feedstocks currently have the lowest cost. The progressing batch and SSF processes were found to be the most promising methods of hydrolysis. Xylose and lignin conversion are essential to the overall yield and economics of the system.

21189 (DOE/CH/10093—6, pp 115-116) **Progressing batch reactor.** Hoagland, W. (Solar Energy Research Institute, Golden, CO). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

Dilute sulfuric acid hydrolysis processes have suffered from low yields (50%-60%), low sugar concentrations (3-5 wt%), and difficulties in moving solids into and out of pressurized reaction vessels. The progressing batch reactor system uses several percolation reactors in series to approximate a counter-current flow of the cellulosic feedstock and the liquid hydrolyzate. The counter-current pattern allows rapid removal of the product sugars from the reaction zone with much lower flow rates than are possible in a percolation reactor. Thus, the higher yields are achieved with increased sugar concentrations. The system also shares the mechanical simplicity of the percolation reactor in that all solids handling is done at atmospheric pressure and low temperature. Phase I, the design and operation of a single-stage reactor, has been completed. The single stage reactor was operated in both a downflow and upflow mode to characterize the effect of flow directions on acid distribution in the reactor bed. Using the single stage data, the design of a multistage system was completed and will be revised based on information to be obtained from operating two reactors in tandem. This will verify the acceptability of the current design for process control and equipment configuration.

21190 (DOE/CH/10093—6, pp 117-118) **Dilute acid hydrolysis in a high temperature reactor.** Hoagland, W. (Solar Energy Research Institute, Golden, CO). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

The objective of this experiment is to determine the feasibility of producing fermentable sugars using a plug-flow, acid-hydrolysis reactor with wood slurry in an engineering scale system. Completing this primary objective will involve (1) maximizing the yields of fermentable sugars by varying temperature, residence time, and acid concentration; (2) identifying and solving potential problems in the operation of the plug-flow reactor and associated equipment; (3) determining operational constraints such as maximum solids loading and required subcooling in the reactor; and (4) generating sufficient quantities of products to test other critical processes, such as solids separation and fermentation. Water and aspen chips approximately 1 mm by 5 mm will be prehydrolyzed. The slurry will be pressurized by a progressing cavity pump, and high-pressure steam will be injected at the head of the reactor to directly heat the slurries to the reaction temperature. The plug-flow reactor will hydrolyze wood slurries (5%-15% solids by weight) at temperatures ranging from 200° to 265°C for 4 to 10 seconds. The hydrolyzate will then be quenched by flashing the slurry, and the vapor and liquid phase will be separated, collected, and analyzed.

21191 (DOE/CH/10093—6, pp 119-120) **Ethanol from cellulosic residues and crops.** Barrier, W. (Tennessee Valley Authority, Muscle Shoals, AL). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

The objective of this project is to develop an economic process for low-temperature, concentrated acid hydrolysis of biomass feedstocks for the production of liquid fuels. The technical approach is divided into four phases. First, an economical process must be developed for recovery and recycle of acid to reduce acid costs. In addition, the utilization of all components of the biomass feedstock must be improved by developing efficient processes for conversion of xylose to ethanol and waste streams to useful products. Thirdly, alternative biomass feedstocks must be studied to expand the resource base for the process. Finally, system flexibility and efficiency will be improved by defining and evaluation process alternatives. Direction of this subcontract was transferred to SERI in September 1986. Work on the project previous to that time demonstrated hydrolysis conversion efficiencies of greater than 90% for both hemicellulose to xylose and cellulose to glucose using a 4 ton-per-day pilot plant. Conversion efficiencies as great as 80% have also been demonstrated in the laboratory for the fermentation of xylose to ethanol. Since this subcontract was placed by SERI, bench-scale studies of sugar-acid separation using activated carbon have demonstrated the continued effectiveness of this technique after repeated adsorption/desorption cycles. Also, engineering studies have defined processing alternatives with the potential to reduce acid requirements by 20% and drying loads by about 67%.

21192 (DOE/CH/10093—6, pp 121) **Lignocellulose hydrolysis using concentrated acid: acid recycle and liquid fuel production.** Tsao, G.T. (Purdue Univ., West Lafayette, IN). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

The objective of this project is to separate mineral acids such as hydrochloric or sulfuric from hydrolyzate solutions containing water, acid, and mixed sugars, in an efficient and inexpensive system. It has been discovered that solid cross-linked polyamine resins can absorb mineral acids from aqueous solutions at very high efficiencies. Further, under different conditions the

amines could be tailored to recover solvents, such as ethanol, or sugars from the aqueous phase. Experiments using packed-bed and stirred-tank reactors have been undertaken to quantify the acid recovery. Also, attempts have been made to construct poly-amine membranes for acid recovery. The poly-amine membranes constructed did not have the physical properties necessary for prolonged use. As development of suitable membranes would be a time-consuming process, effort has been focused on development of packed-bed and stirred-tank separation processes. The resins have shown good mechanical stability and the ability to recover acids in a quantitative manner. Investigation of the adsorption isotherms is currently under way using packed-bed and stirred-tank systems.

21193 (DOE/CH/10093—6, pp 122-123) **Chemomechanical pretreatment of biomass.** Grohmann, K. (Solar Energy Research Institute, Golden, CO). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

The objectives of this project are to establish the performance of dilute-acid pretreatment of biomass and to develop an economically attractive pretreatment process based on this approach for subsequent enzymatic hydrolysis of lignocellulosic biomass. Dilute-acid prehydrolysis of selected biomass feedstocks (aspen wood and wheat straw) will be investigated as a pretreatment for enzymatic hydrolysis of cellulose at moderate temperatures (95° to 160°C) and low (10 wt%) to high (20-50 wt%) concentrations of solids. The kinetics of this process will be measured as a function of temperature, time, and acid concentration, and a model will be developed to predict the rates. The enzymatic digestibility of the cellulose in wheat straw and aspen wood pretreated with dilute acid will be measured as a function of those same parameters. The power consumption for comminution of dry biomass (wood and agricultural residues) to relatively coarse particles (1-25 mm) will be determined before dilute-acid pretreatment. Equipment will be selected and power consumption determined for comminution of wet biomass after dilute-acid pretreatment to fine particles (0.1-1.0 mm). An initial estimate will then be made of the process economics for dilute-acid pretreatment. Dilute-acid pretreatment of aspen bark will be investigated in a similar way to the above, and methods for removal and recovery of lignin will be developed.

21194 (DOE/CH/10093—6, pp 124) **MSW to ethanol process.** Richerson, F.B. (CADCO, Inc., Petersburg, VA). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

The objectives of this project are to evaluate alternative pretreatments for municipal solid waste (MSW), determine the digestibility of MSW after the pretreatment, determine the capital and operating costs of the pretreatments, and determine whether the pretreatments are cost effective. Three mechanical pretreatment methods and one thermochemical pretreatment method have been identified for testing at the pilot scale: (1) Draiswerke Perl (ball) Mill, (2) C.E. Bauer double and single disk refiners, (3) SBM Wegeneder double rotor hammermill, and (4) Stake Technology, Ltd. steam explosion process. Each of these pretreatment equipment types is used to process several thousand pounds of material in order to ascertain the operating characteristics, throughput, and power consumption. Samples of the pretreated material are then sent to the University of Arkansas where they are tested for enzymatic digestibility. The samples will also be used to test the ability of the enzyme-producing fungi to grow on the pretreated MSW feedstock. From these data, capital and operating cost estimates will be made to determine the economic and technical feasibility of each pretreatment.

21195 (DOE/CH/10093—6, pp 128-129) **Simultaneous saccharification and fermentation of cellulose to ethanol.** Wyman, C.E. (Solar Energy Research Institute, Golden, CO). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

Small-scale fermentations are conducted in shake flasks with glucose and cellobiose sugars at temperatures of 30° to 47°C; and researchers measure the rates, yields, and ethanol concentrations for each yeast strain. Then, the most promising yeasts identified through this screening procedure are evaluated in shake flask simultaneous saccharification and fermentations (SSF) with three different enzymes and a pure cellulose substrate. In this way, researchers rapidly evaluate a wide range of enzyme loadings, temperatures, and substrate concentrations to select the most favorable conditions. Finally, the most promising combination of yeast and enzyme are run in larger fermenters so that the fermentation conditions can be controlled more accurately and more measurements can be made of substrate and product concentrations. Eighteen strains of yeasts capable of fermenting the intermediate soluble sugars (cellooligosaccharides) produced by enzymatic hydrolysis of cellulose were screened for fermentation rates, ethanol yields, and final ethanol concentrations when grown on these sugars. Three strains of yeast were identified that have potential for application in the SSF process. The species Brettanomyces clausenii appeared particularly promising since it fermented rapidly to the highest ethanol yields at temperatures up to 37°C, and batch SSF evaluations were conducted for this yeast with three different enzymes. B. clausenii performed better than the conventional brewer's yeast, Saccharomyces cerevisiae, when and with enzymes low in the activity required to break down the simple intermediate sugar cellobiose. A mixed culture of the two yeasts gave better performance at 37°C than either yeast alone or hydrolysis of the cellulose to sugars at 50°C: over 90% of the cellulose was converted to fermentable sugars for the mixed culture SSF runs.

21196 (DOE/CH/10093—6, pp 130-131) **Mixing requirements for the simultaneous saccharification and fermentation of lignocellulose to ethanol.** Murphy, V.G. (Colorado State Univ., Fort Collins). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

The so-called simultaneous saccharification and fermentation (SSF) process converts the cellulose in biomass into sugars and ferments the sugars to ethanol, all in one fermenter containing biomass, enzymes, and yeast. The research to be performed includes both experimental investigations and mathematical modeling. Various cellulosic substrates will be hydrolyzed, and the influence of mixing on hydrolysis and possibly fermentation rates will be measured. The subcontractor will then determine the effect of shear rates on the rate of hydrolysis and fermentation of cellulosic substrates. A model will be developed to provide a quantitative basis for understanding the results. Finally, projections will be made of the minimum power requirements necessary to maintain satisfactory hydrolysis rates. The subcontractor has completed a search of the relevant literature on studies of the effect of mixing on hydrolysis/fermentation rates for hydrolysis of cellulose alone, as well as for SSF systems. A modeling approach is being devised to predict the performance of hydrolysis/fermentation systems as a function of shear rate based on the literature review. Initial experiments have also been performed to determine the relationship between fluid shear rates and hydrolysis/fermentation rates. Further experiments are now being designed to provide quantitative information on both the shear applied and the conversion rates, and the researchers will perform the experiments according to the procedure defined. The model will be evaluated against the experimental results and modified if required to improve the accuracy of its predictions. Based on the experiments and the model, the minimum power requirement for providing satisfactory hydrolysis/fermentation rates will be estimated.

21197 (DOE/CH/10093—6, pp 132-133) **Mathematical modeling of the simultaneous saccharification and fermentation of lignocellulose to ethanol.** Kompala, D.S. (Univ. of Colorado, Boulder). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

The overall objective of this subcontract is to develop a model derived from independent experiments with yeast and enzymes that will predict the performance of simultaneous saccharification and fermentation (SSF) systems with sufficient accuracy to allow optimization of the system and identification of key areas for

improving system performance. A parent strain and two mutants of the cellobiose fermenting yeast Brettanomyces have been grown up on synthetic media, and the best strain and medium composition have been selected for this study. Researchers have determined growth kinetic parameters for the yeast on both glucose and cellobiose. A cybernetic model is being developed to predict the growth of the yeast on glucose and cellobiose. This model acknowledges the fact that cellobiose is a dimer of glucose so that the yeast still retains the ability to use glucose even while growing on only cellobiose. The fermentation characteristics of the yeast are now being studied in a well controlled fermenter for single substrates and a mixture of glucose and cellobiose, and the intracellular and extracellular enzyme activities produced by B. clausenii are being determined. The mixed substrate fermentation results are then compared to the model predictions to determine its accuracy.

21198 (NEDOJ—8401, pp 729-733) **Development of fuel alcohol technology. Breeding of excellent bacteria.** Aug 1984. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770050/JAW.

In FY 1983 NEDO Annual Report.

To develop a screening method of searching excellent bacteria for the ethanol fermentation, research was made by 3 groups. The first group undertook collecting and pigeonholing the documents and information, collecting and evaluation of known bacteria such as fermenting bacteria and thermophilic bacteria, and examining the methods of screening these bacteria. The 2nd group executed the research and screening of alcohol-producing bacteria which are used for the attached-bacteria method, and development and breeding of excellent bacteria by applying biotechnology such as gene operation and cell fusion. In more detail, excellent bacteria were searched among various sources both from inside and outside of Japan, and the methods of their separation and breeding were examined by evaluating their alcohol resistance and heat resistance. The third group. for the purpose of breeding and searching for the bacteria which are suited for flash fermentation process, studied the culturing conditions of Zymomonas bacteria, and conducted the purification test of their strains, as well as the separation and identification of bacteria from the the natural source.

21199 (NEDOJ—8401, pp 734-735) **Development of fuel alcohol technology. Development of attached-bacteria method.** Aug 1984. NTIS (US Sales Only), PC A99. Order Number DE88770050/JAW.

In FY 1983 NEDO Annual Report.

In the process of alcohol fermentation by attached-bacteria method, several items of thchnical development were made such as a long-term continuous operation of the device, simplification of the process, energy saving, germ-free fermentation, and cell high-densification. In more detail, application of process to the attached-bacteria method was studied, mainly based on the bacterial strains, evaluation and analysis through alcohol fermentation test by using Zimomonas. Then the adaptability of the strains to the changing external conditions was evaluated. (For the practical method, a compact device was designed and manufactured. With this device, experiments on alcohol fermentation were made on waste molasses.) According to the data obtained by the performance evaluation test, a test plant with production capacity of 0.1 kl/day was designed, manufactured, and installed in Okinawa.

21200 (NEDOJ—8401, pp 736-738) **Development of fuel alcohol technology. Development of flash fermentation method.** Aug 1984. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770050/JAW.

In FY 1983 NEDO Annual Report.

For completing the flash fermentation system, process composition, establishment of flashing conditions, high densification of optimum bacterial strains, and fermentation characteristics of highly saline fermentation system were studied. By using a small flash fermentor with alcohol production capacity of 1 l/day, each element study was made by a long-term operation. This study has formed a basic concept of the process, and at the same time a basic designing was performed for a bench scale plant with a production capacity of 5 kl/day as a fundamental reference material for the construction in the next fiscal year. Details of the research are as follows: By using the existing semi-midget plant, the flash fermentation system composing temperature, pressure, and the circulation ratio were studied by means of a simulated liquid consisting of water and alcohol. Then by testing through a model fermentor, it was proved that a fermentation method with 3 connected fermentors was most effective. Those tests also brought about a result of selecting very promising materials for the high-densification.

21201 (NEDOJ—8702, pp 429-430) **Technical development of alcohol for fuel. Inspection and breeding of superior bacteria.** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770076/JAW.

In FY 1986 NEDO annual report (Part 2).

Heat- and alcohol-resistant bacteria for alcoholic fermentation were separated from the soils in Japan and abroad and the performance was evaluated to develop superior bacteria for ethanol fermentation. The superior bacteria pertinent to alcoholic fermentation were bred by domestication, variation treatment, cell fusion and gene manipulation. The productivity of ethanol was increased by controlling pH of thermophilic, aerobic cellulase and culturing the mixture of added nutrients. CMC ase and Beta-glucosidase genes, the component enzymes of cellulase, were successfully developed by Zymomonas sp. A promotor selecting vector of Zymomonas was produced for developing xylolase gene to acquire an active promotor.

21202 (NEDOJ—8702, pp 431-432) **Technical development of fuel alcohol. Development of attached bacterial cell method.** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770076/JAW.

In FY 1986 NEDO annual report (Part 2).

The applicability of the superior bacteria which had been explored and bred to the attached bacterial cell method was examined by the continuous fermentation test in a small fermenting vat to evaluate the cells. A test plant of 1 kl of alcohol per day was operated to find out the problems in the long-term, continuous operation. The ratio of dilution of 1/0.25, the concentration of product alcohol of 57 g/l and the yield of fermentation of 74% were achieved by the operation of test plant. The performance of fermentation was varied according to the ash content in the waste molasses. No carrier better than vermiculite was found out by the fermentation test. The phase of bacteria was examined at the startup and during the continuos operation of the test plant. The selection and evaluation of the strains suited for the attached bacterial cell method will be continued.

21203 (NEDOJ—8702, pp 433-434) **Technical development of fuel alcohol. Development of flash fermentation process.** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770076/JAW.

In FY 1986 NEDO annual report (Part 2).

The test plant of 5 kl of alcohol per day was partially reformed for saving energy and the continuous operation was carried out. The technology of higher concentration of bacteria was developed for improving the reaction rate to bacteria and the effect of salts. The fuel alcohol manufacturing process incorporating the flash fermentation process was technically and economically evaluated. The continuous flashing test using an artificial culture medium was made. The result indicates that the high concentration fermentation of 340 g/l or more of the feed sugar and 20 vol% or more of the product alcohol is feasible in the culture medium without salt. The productivity at those concentrations is as high as 21 kg/m^3. It is estimated that the stable, continuous flash fermentation operation at 35°C is feasible in the 5 kl/d-test plant and the cost is approximately 20% less than that by the conventional process.

21204 (NEDOJ—8702, pp 435-436) **Technical development of fuel alcohol. Research and development for total system.** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770076/JAW.

In FY 1986 NEDO annual report (Part 2).

The purpose of this study is to develop a process efficiently produce fuel alcohol. The study was initiated in 1986. The conditions of pulverizing wood chip and the effect of various solvents treating the pulverized material were investigated to use wood biomass as the raw material for alcohol in the first year, FY1986. The findings in FY 1986 are as follows: the rate of saccharification is increased by treating the sample with liquid or gaseous auxiliary

before the pulverization with high-pressure steam; ozone is the most effective auxiliary; the effect of removing the lignin decomposition product by solvent extraction from the pulverized Japan ceder was examined; the result indicates that non-protic solvents such as acetone and dioxane are more efficient for removing the raw material for fermentation than protic solvents such as isopropanol and ethanol; and the pulverizing conditions without auxiliary and the multi-stage pulverization system suited for scaling-up were investigated.

21205 (NEDOJ—8702, pp 437-441) **Development of methane manufacturing equipment with combined high-performance separation membrane.** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770076/JAW.

In FY 1986 NEDO annual report (Part 2).

The purpose of this study is to develop the equipment for manufacturing methane from organic matters in waste water by the combination system of the bioreactor for fermenting methane with the modular separation membrane. In FY1986, the fundamental research on various types of modular membrane such as organic and inorganic membranes for fermenting methane was made and the regenerating function of the surface of porous membrane using an organic binder was determined. The ultrafilter membrane using polyvinyl alcohol was manufactured on an experimental basis. The experiments in the removal technique of suspended matter and the solubilization of suspended organic matters were made. The relationship of the material and shape of carrier with the acceleration of fermentation was examined in fixed-bed and fluidized-bed bioreactors. It was confirmed that the undecomposed organic matters and bacteria can be prevented from running out of the reactor by combining the membrane. A program for computer control of the separation equipment comprised of the reactor with the membrane was made. (2 figs, 1 tab, 1 photo)

21206 (NEDOJ—8702, pp 442-444) **Demonstration test of methanol conversion for oil-fired power plant. Research on components of methanol reformed gas power generation.** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770076/JAW.

In FY 1986 NEDO annual report (Part 2).

The purpose of this study is to increase the efficiency of methanol reformed gas-fired power plant and establish the technology for commercialization. In FY1986, the improvement and test of modified catalyst, the heat recovery and reaction processes and combustion were carried out using the bench-scale test equipment designed and constructed in the previous year. It was found that a copper-nickel catalyst is excellent in the activity and service durability. The preventive method against the deposition of carbon on the natural zeolite catalyst was examined. The tests of characteristics of reaction and stability of heating medium in the heat recovery and reaction processes were carried out using the test equipment. The types of gas turbine and reactor were evaluated. As a result, it was found that the modified gas turbine and heating medium type reactor are practical. For the combustion test, the ignition ability experiment was made and the combustion systems by water and steam injection and the two-stage combustion system were investigated to decrease the NOx content and it was confirmed that the two-stage combustion system is more effective for decreasing the NOx content.

21207 **(NZERDC—151) Potential for diesel and fuel oil replacement: Final report.** (Gabites Porter and Partners, Christchurch (New Zealand)). Sep 1987. 168p. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88900402/JAW.

This study was commissioned by the New Zealand Energy Research and Development Committee in New Zealand in order to update an earlier description of the use of diesel, and the potential for diesel replacement prepared for the LFTB in 1981. This present study went further in that it looked at the marine and transport sectors excluded from the earlier work, and it has also covered usage of the fuel oils. A secondary objective was the preparation of a robust data set on which to base this and other studies in the field. 9 figs., 9 tabs.

21208 **(ORNL/Sub—85-22007/3) Status of alcohol fuels utilization technology for highway transportation: A 1986 perspective: Volume 2, Compression ignition engines.** (Mueller Associates, Inc., Baltimore, MD (USA)). Jan 1988. Contract AC05-84OR21400. 442p. NTIS, PC A19/MF A01; 1; GPO Dep. Order Number DE88006059/JAW.

The current status of the technologies of alcohol utilization in highway transportation diesel engines is reviewed. The use of methanol, ethanol, and certain of their derivatives in diesel-engine-powered vehicles is treated in this volume. Volume I covered alcohol utilization in vehicles powered by spark ignition engines. The results of engine, vehicle, and fuels testing are summarized. The topics of fuel properties, power output, fuel consumption, thermal efficiency, ignition delay, rate of pressure rise, engine noise, operability, exhaust emissions, smoke, materials compatibility, engine wear, and safety are discussed based on the data available at this time. The status of the technology at the time of the last comprehensive survey (1981) is summarized and discussed. Significant advances made since that time are delineated, as are remaining information gaps and areas in which more extensive investigation is still needed. 269 figs., 37 tabs.

21209 **(PB—88-133988/XAB) Fuel ethanol cost-effectiveness study.** Gavett, E. (National Advisory Panel on Cost-Effectiveness of Fuel Ethanol Production (USA)). Nov 1987. 158p. NTIS, PC A08/MF A01.

Based on an extensive review and analysis of available data and information on ethanol production and the U.S. energy situation, as well as a limited amount of new modeling of the impacts of increased levels of ethanol production. The report is drawn from data and information provided by fuel ethanol producers, the Congressional Research Service, the Environmental Protection Agency, Department of Agriculture, Department of Energy, and others. The study uses three ethanol production scenarios to illustrate the type and magnitude of impacts ethanol could have on various aspects of the U.S. economy over the next 5 years. Of these, a 3.4 billion gallon/year scenario was viewed as an upper limit to possible ethanol industry expansion by 1992.

21210 **(PB—88-856091/XAB) Alcohol fuels: production. September 1985-December 1987 (citations from the NTIS data base). Report for September 1985-December 1987.** (National Technical Information Service, Springfield, VA (USA)). Jan 1988. 45p. NTIS PC N01/MF N01.

This bibliography contains citations concerning the synthesis of alcohol fuels, including gasohol. Alcohol production from sugar beets, industrial wastes, hardwood, biomass, and coal conversion processes are discussed. Cellulose and lignin degradation processes are described. Production systems are evaluated. The utilization of alcohol fuels is discussed in a separate bibliography. (Contains 75 citations fully indexed and including a title list.)

21211 **(PB—88-856109/XAB) Alcohol fuels: utilization. September 1985-December 1987 (citations from the NTIS data base). Report for September 1985-December 1987.** (National Technical Information Service, Springfield, VA (USA)). Jan 1988. 105p. NTIS PC N01/MF N01.

This bibliography contains citations concerning the utilization of alcohol fuels, including gasohol. The use of alcohol fuels in internal combustion engines, diesel engines, automobiles, trucks, and buses are among the topics discussed. Characterization of exhaust emissions from alcohol fuels, waste heat recovery, and machinery endurance are included. Production of alcohol fuels is discussed in a separate bibliography. (Contains 197 citations fully indexed and including a title list.)

21212 **(SERI/TP—231-3310) Economics of enzymatic hydrolysis processes.** Wright, J.D. (Solar Energy Research Inst., Golden, CO (USA)). Feb 1988. Contract AC02-83CH10093. 48p. (CONF-880348—2). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001134/JAW.

From American Institute of Chemical Engineers spring national meeting; New Orleans, LA, USA (6 Mar 1988).

Enzymatic hydrolysis processes have the ability to produce high yields of sugars for fermentation to fuel ethanol from lignocel-

lulosic biomass. However, these systems have been plagued with yields, product concentrations, and reactions rates far below those that are theoretically possible. Engineering and economic analyses are presented on several fungal enzyme hydrolysis processes to illustrate the effects of the important process parameters, to quantify the progress that has been made to date, and to estimate the cost reductions that can be made through research improvements. All enzymatic hydrolysis processes require pretreatment, hydrolysis, fermentation, and enzyme production. The key effect of pretreatment is to allow access of the enzymes to the substrate. Pretreatments have been devised that make the biomass completely digestible that increase the xylose yield and concentration, and that integrate pretreatment with lignin utilization. Major improvements in enzyme activity and use of simultaneous saccharification and fermentation (SSF) have greatly reduced the inhibition of the enzymes. It now appears that ethanol inhibition of the yeast is the limiting factor. Enzyme production costs have been dramatically reduced because use of SSF has reduced enzyme loading. However, further improvements may be possible by using soluble carbon sources for production. Over the past decade, the predicted cost of ethanol from such processes has dropped from more than $4.00/gallon to approximately $1.60. Research is currently under way in the United States and has the potential to reduce the projected cost to less than $1.00/gallon. 65 refs., 16 figs., 1 tab.

0904 Solid Waste And Wood Fuels

REFER ALSO TO CITATION(S) 21149, 21151, 21166, 21347

21213 **(AERE-R—12696) Municipal solid waste conversion to energy: a summary of current research and development activity in Sweden.** Krol, A.; Dent, C. (UKAEA Harwell Lab. Environmental and Medical Science Div.). Aug 1987. 181p. H.M. Stationery Office, London, price Pound 10.

A report written as part of the MSW Conversion Activity, Task IV, IEA Biomass Energy Agreement.

In Sweden, about 50% of municipal solid waste (MSW) is incinerated untreated in grate furnaces and used in district heating networks. Incinerator emissions have been a cause of concern and their reduction is the object of much current research and development. Refuse derived fuels (RDF) produced in separation/composting plants is perceived as having considerable future market potential, most particularly for use in circulating fluidized bed combustors. Pyrolysis technology is being investigated, both as a means of producing a combustible gas from RDF and in the gasification of untreated MSW. Interest is rapidly expanding in landfill gas extraction. The report examines current research and development projects in all these areas and includes descriptions of working plant.

21214 **(AFME—83-039) Various ways for the wood biomass energetic upgrading. The dry way.** Robert, P. (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). 1984. 105p. (In French). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88752276/JAW.

The various by-products issued from harvesting stem woods or sprout forests (bark, stumps, coppices, etc.) and issued from the various wood industries (saw-dust, barks, scraps, etc..) are described and their availability is discussed (volume and lost). The main upgrading dry processes are presented (combustion, pyrolysis and gasification) and their energetic and economical efficiencies are evaluated and compared with other fuels in different economical and industrial situations.

21215 **(AFME—83-0825) Forest biomass energetic upgrading Technical - economical analysis of the process conditions in big wood furnaces with non-shredded wood.** (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). 1983. 265p. (In French). NTIS (US Sales Only), PC A12/MF A01. Order Number DE88752270/JAW.

Traditionally big wood furnaces burn small bricks of wood. As the shredding of the wood pieces is costly, the possibility of wood furnaces burning non-shredded wood pieces (1 meter long logs) is studied. The various materials needed for the handling of the logs are reviewed and evaluated and the wood furnaces that could be used to burn such bulk logs of various dimension, barks and wood industry scraps are studied. An economical assessment of the global process is presented (raw materials, furnaces, manual labour, transportation,...).

21216 **(AFME—85-91-1001-8) Wood energy utilization development: comparison with other utilizations of wood and its effects.** Robin, S. (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). 1986. 127p. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88752266/JAW.

The various uses of small wood products are described and their long term and mean term evolution is analysed: paper pulp production, particle and fiber board production and wood firing. Supply volume and prices are calculated. The influences of the development of the energetic use of wood (mainly for heating purposes) on the other uses (paper pulp, particle board) are then examined and simulated for different conditions such as the oil and wood prices and the small wood future disponibilities in France.

21217 (DOE/CH/10093—6, pp 167-168) **Development of wood as an alternative fuel for gas turbines.** Hamrick, J.T. (Aerospace Research Corp., Roanoke, VA). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

The objective of this project is to develop a wood fueled combustor/gas turbine generating system. Four main tasks have been defined to accomplish the project objective: (1) operate a wood combustor/375-kW gas turbine system at elevated pressure on pulverized wood to evaluate the effectiveness of cyclone filters for cleaning the combustion gases, thereby preventing turbine erosion; (2) assemble a wood combustor/3000-kW gas turbine generating system at Roanoke, Virginia; (3) evaluate the particular removal efficiency of scaled-up cyclone filters by sampling the gas stream entering the turbine; (4) upon determining that the filtering process is adequate, move the system to Red Boiling Springs, Tennessee, and perform a 3000-hour endurance test using hardwood sawdust as the fuel. Tests with the 375-kW turbine system were completed with positive results. The 3000-kW system has been constructed and tested. Sampling of the gas stream was performed by Battelle Columbus Laboratories personnel with positive results. The tests revealed that 86% of the particulates entering the turbine were less than 0.55 μm in diameter. The 3000-kW system has been moved to Red Boiling Springs and is undergoing a series of system shakedown tests. Testing to date has resulted in several modifications to the design in order to obtain the desired operating conditions for the turbine. Deposition of fine ash on the turbine blades has been identified as a potential system constraint.

21218 (DOE/CH/10093—6, pp 169) **Research on manure as a feedstock for gas turbines.** Hamrick, J.T. (Aerospace Research Corp., Roanoke, VA). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

The objective of this project is to evaluate turbine wear and performance using manure as the fuel in a pressurized wood combustor, gas turbine generator system, designed to burn wood. The manure has been obtained and characterized, and a preliminary assessment of the ash behavior has been made. Preliminary tests using the combustor using manure have revealed no problems in the turbine. However, slagging of manure ash in the combustor has been identified as a possible constraint to the concept.

21219 (DOE/CH/10093—6, pp 170) **Conversion of forest residues to a methane-rich gas in a high throughput gasifier.** Feldmann, H.F. (Battelle Columbus Labs., OH). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

The objective of this work is to develop a process to gasify biomass by circulating hot sand from a separate char combustor to the gasifier, thereby providing an indirect source of heat. An entrained bed gasifier would be coupled to a separate fluidized bed

char combustor so that sand could circulate between the two vessels. Experiments would be conducted to evaluate the performance of the coupled system and to determine the optimum operating parameters. The data will be evaluated to develop conceptual process designs. A Process Research Unit containing a 10-in. entrained gas gasifier coupled to a fluidized bed char combustor has been constructed and operated on wood at through puts up to 1800 lb/h. Experiments have evaluated the effect of temperature, wood moisture content, and feed rate on gasifier performance. A three-day continuous test evaluated long-term effects on system performance. Data analysis and process modeling have been performed to evaluate the concept and to develop a process flowsheet for an integrated gasifier/char combustor system.

21220 (DOE/CH/10093—6, pp 195) **External combustor system analysis.** Helt, J.E. (Argonne National Lab., IL). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

The objective of this project is to evaluate the concept of combining an MSW modular mass-burning combustor with an existing steam plant. Three tasks were identified to meet the project objective: (1) determine the technical constraints based on the performance limits of existing equipment, (2) identify the main elements in the cost model and develop simplified algorithms to relate costs for all alternatives to be considered, and (3) combine the performance models and cost models in an overall computer code. An overall technical and economic assessment can then be completed using the computer code. It is also possible to use the code to perform a sensitivity study, subject to previously determined constraints, for each alternative concept and for each potential application. A computer code, SALT/MSW, has been developed for the combined technical and economic assessment. The code has been used to obtain preliminary results for various options of integrating the external combustion with an existing fossil-fuel-fired facility.

21221 (DOE/CH/10093—6, pp 196-197) **System integration modeling for the production of refuse-derived fuel (RDF).** Ohlsson, O. (Argonne National Lab., IL). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

The objective of this project is to develop the basic understanding and theory of RDF unit operations and their proper sequencing in a processing system to economically produce the desired refuse-derived fuel product for use in existing systems and for use in other thermochemical and biochemical conversion processes. State-of-the-art models for simulating the mass balance, energy requirements, and economics of the unit operations that typically comprise RDF processing systems were completed in FY 1984 under contract to Cal Recovery Systems. A follow-on phase of this study by Argonne National Laboratory (ANL) used the unit operations models developed by Cal Recovery as input into an existing ANL system level computer code. This code is written in FORTRAN for use on an IBM-PC. The utility of this computer code, known as GARB, is its capability to assess the performance of various RDF processing systems in order to define technically and economically sound processing systems in order to define technically and economically sound processing alternatives that can produce a desired RDF fuel form. Moreover, the model can also be used to optimize existing inefficient processing systems, by identifying changes in equipment operating conditions or to identify under what circumstances the use of additional equipment for another will increase the quality of the recovered RDF. In FY 1986, the draft version of the computer code software and the user's/programmer's documentation manual were submitted for review to a peer review committee composed of facility operators, system designers, equipment manufacturers, and academia. The code is also being validated by the U.K.'s Warren Spring Laboratory on a commercial operating RDF processing facility.

21222 (DOE/CH/10093—6, pp 200) **Combustion product kinetics model.** Helt, J.E. (Argonne National Lab., IL). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

The objective of this project is to develop an analytical computer model that could predict the formation of combustion products under different operating conditions. Such a model would be a valuable tool to the combustion industry in predicting performance and minimizing the formation of toxic products from the combustion of municipal solid wastes. Three tasks have been identified for the project: (1) review of available data base and existence of similar models, (2) completion of data base where needed information is lacking, and (3) development of a model. At all stages, there will be close interaction with the commercial sector and other appropriate research labs such as National Bureau of Standards (NBS). Preliminary work is being undertaken to determine if the data base is available to produce a model that will describe the combustion process and the formation of products not only during combustion but also during cooling of the combustion products in the heat recovery and gas cleanup systems. A literature review is being performed. Work is also ongoing to determine what similar models have been developed in other areas (such as coal combustion), what data is required for implementing these models, and what usefulness is gained from their application.

21223 (DOE/CH/10093—6, pp 201-202) **Densified fuel preparation from municipal solid waste.** Daugherty, K.E. (North Texas State Univ., Denton). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

Three tasks have been defined to accomplish the project objectives: (1) conduct comprehensive chemical and physical tests of binder-enhanced densified refuse-derived fuel (dRDF) pellets fabricated at the Jacksonville Naval Air Station, (2) initiate combustion emission characteristics tests for the binder-enhanced dRDF pellets, and (3) evaluation alternative densification techniques for processing binder-enhanced dRDF pellets. The laboratory test phase examined more than 100 potential dRDF binders and binder combinations. The 13 most promising candidates resulting from the analysis and laboratory testing were selected for field testing. The pellets that were produced (53 individual runs were made) were then subjected to a battery of chemical and physical tests. Studies completed to date indicate that (1) the best binder appears to be calcium oxide or calcium hydroxide, or combinations of binders containing either calcium oxide or hydroxide; (2) binders increase the bulk specific gravity of the pellets substantially, and the binders increase the percentage of the plug three-eights size fraction of the pellets; (3) if the binder is calcium oxide or hydroxide, the cost in bulk is approximately $0.0025/lb. Cement kiln dust can also contain more than 20% calcium oxide and is available from some cement plants at no cost; (4) the optimum moisture content of the pelletization process is about 15%. From the tests conducted at the Jacksonville Naval Air Station, it was not possible to produce a pellet with greater than 28%-29% moisture. When calcium hydroxide was used as a binding agent, it was possible to produce pellets with up to 36% moisture; and (5) preliminary laboratory-scale combustion tests indicate that the binder-enhanced dRDF pellets have the potential for reducing toxic emissions from the combustion of the pellet.

21224 (DOE/CH/10093—6, pp 203-204) **Powdered fuel preparation from MSW.** Venables, B.J. (North Texas State Univ., Denton). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

The objective of this project is to develop the data base for producing a powdered refuse-derived fuel product that is economically viable, chemical and biologically stable under long-term storage, and environmentally acceptable. A draft test plan has been developed together with a preliminary identification of possible embrittlement agents to be studied. Two tasks have been defined to accomplish the project objectives during FY 1987: (1) to understand the chemical mechanisms of the embrittlement processes that will permit the recommendation of powdered refuse-derived fuel (pRDF) process conditions that are cost effective and environmentally acceptable and (2) to initiate the physical testing of candidate

pRDF products to identify the various physical handling characteristics.

21225 (DOE/CH/10093—6, pp 208-209) **Monitoring the fate of chlorine during the combustion of MSW.** Domalski, E.S. (National Bureau of Standards, Gaithersburg, MD). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

The objective of this project is to provide a fundamental understanding of the thermodynamic and kinetic processes that occur during the combustion of municipal solid waste (MSW) with a view toward process optimization. Thermodynamic and kinetic measurements are being carried out to accomplish the project objective. Combustion measurements are being conducted in which mass balance determinations for chlorine are made to establish operating conditions for controlling or eliminating the generation of chlorinated dioxins, furans, biphenyl, or benzenes. The distribution between chlorinated substances in the effluent and ash portions is also sought as well as changes in the distribution caused by the presence of lime in the input waste stream. Kinetic measurements are being carried out to determine the mechanisms and rate of destruction of dioxin-type molecules. Chromatographic analysis has shown that chlorinated organic compounds are easily formed during MSW combustion in the large sample flow calorimeter. Modifications to the combustor, which remove it from the calorimeter, have been made so that experimental operating conditions and results are more relative to the real-world incinerator situation.

21226 (DOE/CH/10093—6, pp 212) **Bioenergy project development guidebook.** Vranizan, J.M. (Carroll, Hatch & Associates, Portland, OR). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

The objective of this project was to develop a reference document that will assist plant and corporate managers, public institutions managers, and financial officers in determining the technical and economic feasibility of using biomass fuels in proposed facilities. The publication is intended to provide accurate and authoritative information on the recovery and use of biomass fuels as an alternative to fossil fuels. The information to be included will address areas of concern or interest: (1) fuel supply, (2) conversion technology and engineering, (3) environmental considerations, (4) economics and financing, and (5) specific equipment descriptions and representative prices. A draft report The Biomass Energy Project Guide Book has been submitted and reviewed. As laid out, the handbook has four main purposes: (1) to acquaint the readers with biomass fuels and biomass energy projects, particularly those used in the Pacific Northwest (2) to explain how to assess the feasibility of using biomass fuels, (3) to present the steps involved in planning a biomass energy project, and (4) to point readers to sources of additional information.

21227 **(ETSU-L—21) Straw as a fuel in the UK.** Hare, P.M. (UKAEA Harwell Lab. Energy Technology Div.). 1987. 16p. (CONF-8710281—). British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

From PIRA international conference: straw - a valuable raw material; Cambridge, UK (27 Oct 1987).

Straw could be put to cost effective use as fuel on the farm as well as in local industry and rural institutions. Already, 166,000 tonnes/year (0.09 Mtce/y) are used on farms. Straw is just starting to be used as fuel off the farm, and ETSU estimate that the use in rural industry and institutions could reach 0.8 Million tonnes/year (0.42 Mtce/y) by the year 2000. A series of proving trials followed by an extended period of operation has been conducted to burn straw in industrial coal fired boilers; up to 50% substitution can be achieved on a variety of boiler types. So that existing coal feed systems may be used for straw on industrial boilers, low cost wafering technology is being developed to collect straw from the field and produce wafers directly. Several related projects are underway too, at a total value of Pound 1.5M.

0906 Gaseous Waste Fuels

REFER ALSO TO CITATION(S) 21179

13 HYDRO ENERGY

1306 Environmental Aspects

21228 **(DOE/BP/14383—3) Salmon River habitat enhancement: Annual report, FY 1986, Part 1 of 2.** Richards, C.; Cernera, P.J. (Shoshone-Bannock Tribal Fisheries Dept., Fort Hall Reservation, ID (USA)). Nov 1987. Contract AI79-84BP14383. 110p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88003276/JAW.

The tribal project annual report contains reports for four subprojects within Project 83-359. Subproject I involved fish inventories in Bear Valley Creek, Idaho, that will be used in conjunction with 1984 and 1985 fish and habitat pre-treatment (baseline) data to evaluate effects of habitat enhancement on the habitat and fish community in Bear Valley Creek overtime. Subproject II is the coordination/planning activities of the Project Leader in relation to other BPA-funded habitat enhancement projects that have or will occur in the upper-Salmon River basin. Subproject III involved fish inventories (pre-treatment) in the Yankee Fork drainage of the Salmon River, and habitat problem identification on Fivemile and Ramey Creek. Subproject IV involved baseline habitat and fish inventories on the East Fork of the Salmon River, Herd Creek and Big-Boulder Creek. Individual abstracts have been prepared for the four subproject reports. 20 refs., 37 figs., 22 tabs.

21229 (DOE/BP/14383—3, pp 1.1-1.33) **Bear Valley Creek: Enhancement and inventory: Subproject I.** Nov 1987. NTIS, PC A06/MF A01. Order Number DE88003276/JAW.

In Salmon River habitat enhancement: Annual report, FY 1986, Part 1 of 2.

Fine sediments from a privately owned inactive dredge mine near the headwaters of Bear Valley Creek have covered spawning gravels and filled in rearing habitat of chinook salmon (Oncorhynchus tshawytscha) and steelhead trout (Salmo gairdneri) in the stream from the mid-1950's to 1986. Habitat enhancement efforts via a project funded by Bonneville Power Administration have begun to decrease sediment recruitment from reaches within the mined area. The effects of reduced sediment recruitment will be evaluated by monitoring aquatic habitat and fish communities over time. Physical variables were measured in seven sites within each of seven strata along the length of Bear Valley Creek. In 1986 fish species present in Bear Valley Creek were chinook salmon, mountain whitefish (Prosopium williamsoni), steelhead/rainbow trout, brook trout (Salvelinus fontinalis), cutthroat trout (S. clarki), bull trout (S. confluentus) and shorthead sculpin (Cottus confusus).

21230 (DOE/BP/14383—3, pp vp) **Middle Fork/Upper Salmon River: Planning and coordination: Subproject II.** Nov 1987. NTIS, PC A06/MF A01. Order Number DE88003276/JAW.

In Salmon River habitat enhancement: Annual report, FY 1986, Part 1 of 2.

Carl Richards, Project Leader (PL) and his predecessor, Richard C. Konopacky (January-February), consulted with Bonneville Power Administration (BPA), Idaho Department of Fish and Game (IFG), the Boise National Forest (BNF), Sawtooth National Recreation Area (SNRA), the Challis National Forest (CNF) and private landowners concerning ongoing and proposed habitat enhancement projects in the Upper Salmon River and Middle Fork of the Salmon River drainages. The majority of the PL's time was spent in conjunction with BPA project No. 84-24; Marsh, Elk, Bear Valley, Valley and Upper Salmon River, Idaho. The Fort Bridger Treaty of 1868 entitles tribal members to fish in the Salmon River drainage and was used as the criteria for Tribal involvement in project coordination efforts and the cooperative management of anadromous fish resources within Treaty areas. On January 15 and February 6-7 the PL met with BNF, SNRA, and IFG representatives to discuss work statement changes to the contract between the

BNF and their contractor OEA Research concerning project No. 84-24. Discussions centered on clarifications and additions to the existing work statement that were needed to satisfy the intent of the BPA funded stream habitat inventory.

21231 (DOE/BP/14383—3, pp 3.1-3.30) **Yankee Fork of the Salmon River: Inventory, problem identification and enhancement feasibility: Subproject III.** Nov 1987. NTIS, PC A06/MF A01. Order Number DE88003276/JAW.

In Salmon River habitat enhancement: Annual report, FY 1986, Part 1 of 2.

Extensive dredge mining has degraded chinook salmon (Oncorhynchus tshawytscha), steelhead trout (Salmo gairdneri), and resident salmonid habitat in the Yankee Fork drainage of the Salmon River. An ongoing feasibility study will determine the feasible alternatives for enhancing salmonid habitat, which will influence production throughout the drainage. Subsequent negotiations with an interagency task force will produce a preferred alternative addressing the potential for enhancement of the Yankee Fork to increase critically needed habitat. A construction easement will then be needed from private landowners prior to implementation. Aquatic habitat of fish communities were inventoried in the Yankee Fork of the Salmon River, Jordan Creek and the West Fork of the Yankee Fork of the Salmon River (the latter two streams are tributaries to the Yankee Fork) during 1984 and 1985 for use as pretreatment data to evaluate anticipated habitat enhancement. Physical and biological variables have been measured in six sites within seven strata of the Yankee Fork drainage. Fish data were collected via snorkel-observations and electrofishing. Salmonid species present in the Yankee Fork drainage include: chinook salmon, steelhead/rainbow trout, mountain whitefish (Prosopium williamsoni), brook trout (Salvelinus fontinalis), cutthroat trout (S. clarki), and bull trout (S. confluentus). Shorthead sculpin (Cottus confusus) were also present.

21232 (DOE/BP/14383—3, pp 4.1-4.23) **East Fork Salmon River: Habitat and fish inventory, 1986 and Herd Creek: Fish inventory, 1986.** Nov 1987. NTIS, PC A06/MF A01. Order Number DE88003276/JAW.

In Salmon River habitat enhancement: Annual report, FY 1986, Part 1 of 2.

Aquatic habitat and fish community of East Fort and Big Boulder Creek, a tributary to the East Fork, were inventoried for use in identifying habitat problems for anticipated habitat enhancement. Biological inventories continued to be monitored on Herd Creek, as part of the problem identification inventory initiated in 1985. Physical and biological variables were measured in six sites within six strata along most of the East Fork (46.7 km) during July and August 1986. Fish data were collected via snorkel-observations and electrofishing. Minimum and maximum water temperatures ranged from 3 to 21 C, between 21 July and 22 August. Riffle area, pool area, stream width, pool depth, and gradient, differed significantly among strata. A significantly higher frequency of fine (<8 mm diameter) sediments occurred in Herd Creek (stratum 2) than in all other strata. In decreasing order of abundance, salmonid species in the East Fork of the Salmon River included: chinook salmon, mountain whitefish (Prosopium williamsoni), steelhead/rainbow trout (Salmo gairdneri), and bull trout (Salvelinus confluentus). 6 refs., 10 figs., 6 tabs.

14 SOLAR ENERGY

REFER ALSO TO CITATION(S) 21906

21233 **(NEDO-OS—8603) FY 1985 annual report. Solar energy technology.** (New Energy Development Organization, Tokyo (Japan)). Mar 1986. 602p. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88770063/JAW.

This report presents results of solar energy technology development carried out by the New Energy Development Organization in fiscal 1985. In pursuit of methods for mass production of low cost solar cells, studies are made on materials including silicon and substrates as well as techniques for production processes and systems. A pilot plant with a production capacity of 200 tons per year of trichlorosilane (TCS) is in operation. A method is developed to produce TCS by hydrogenating and quenching low-cost siliconetetrachloride material. Another method developed serves for producing high-purity silica and silicon from low-quality silica sand. For amorphous solar cells, studies are made on production methods, quality improvement, new materials, requirements for large-size cells, and practical applications. Efforts are made to develop a power generation system using solar cells to serve for energy storage and combined utilization of electric power and solar heat. Case studies are performed to examine the application of solar cells to schools, plants and remote islands. Development of large-scale wind energy conservation systems is also under way. (188 figs, 68 tabs, 11 photos)

1401 Resources And Availability

21234 **(SERI/TR—215-3117) An initial development of a methodology for siting solar power plants.** Maxwell, E.L.; Rymes, M.D. (Solar Energy Research Inst., Golden, CO (USA)). Nov 1987. Contract AC02-83CH10093. 45p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001126/JAW.

The objective of the research described in this report is to develop a methodology for siting solar power plants and to transfer this siting technology to utilities and to solar industries. This report describes the initial development of this methodology, which makes use of SERI's Geographic Information and Data Analysis System (GIDAS). GIDAS functions include data entry, geographic and parameter transformations, image and geographic information analyses, and the production of various output products, including color and black-and-white composite maps and tabular summaries of analytical results. The composite maps in the report show, among other things, direct normal insolation, land use and land cover, land management, and proximity to load centers, all of which are taken into account in selecting suitable sites for solar power plants, using a cost/benefit approach. The methodology is very promising, and awaits only some improvements in insolation data and in current data gases to be developed more fully. 11 refs., 16 figs., 4 tabs.

21235 **Solar irradiance on vertical surfaces.** Stoffel, T.; Maxwell, E.; Bird, R.; Myers, D. (Solar Energy Research Institute, 1617 Cole Blvd., Golden, CO 80401). *Passive Solar Journal;* 4: No. 2, 187-210(1987).

The solar radiation resource data available for passive design studies are generally measurements or model estimates of the global horizontal or direct beam solar irradiance or both. Several methods have been developed for converting these historical data to the solar irradiance available on a sloping surface. The authors evaluated five such methods using a limited set of solar irradiance measurements taken at their outdoor laboratory over a 41-day period, 22 July to 4 September 1984. The preliminary and limited results indicate all five algorithms overestimate (18%-46%) the solar irradiance on north-facing vertical surfaces and perform the best (+-5%) for south-facing surfaces. The authors' estimate of the total measurement uncertainty associated with this analysis is +-5.6%.

1405 Solar Energy Conversion

REFER ALSO TO CITATION(S) 21141, 21142, 21143, 21144, 21145, 21146, 21147, 21148, 21149, 21150, 21151, 21152, 21153, 21154, 21155, 21156, 21157, 21158, 21159, 21160, 21161, 21162, 21163, 21164, 21165, 21166, 21167, 21168, 21169, 21170, 21171, 21172, 21173, 21174, 21175, 21176, 21179, 21182, 21183, 21184, 21185, 21186, 21187, 21188, 21189, 21190, 21191, 21192, 21193, 21194, 21195, 21196, 21197, 21201, 21202, 21204, 21205, 21212, 21214, 21215, 21216, 21217, 21218, 21219, 21220, 21221, 21222, 21223, 21224, 21225, 21226, 21227, 21376, 22803, 22812, 22891, 22894, 22895, 22896, 22897, 22898, 22899, 22900, 22901, 22902, 22903, 22950, 22951, 22952, 22953, 22954, 22955, 22956, 22957, 22958, 22959, 22960, 22961, 22962, 22963, 22964, 22965, 22966, 22967, 22968, 22969, 22970, 22971, 22972

21236 **(AD-A—186858/7/XAB) Variable-band-gap materials for thermophotovoltaic generators. Technical report (Final), 1 April 1986-31 August 1987.** Woolf, L.D.; Duggan, D.M.; Smith, J.N. (GA Technologies, Inc., San Diego, CA (USA)). Aug 1987. 66p. (GA-A—18953). NTIS, PC A04/MF A01.

The objective of this research program was to design and develop direct-band-gap solar cells which would have high below-band-gap energy (infrared (IR)) reflectivity for use in high-efficiency thermophotovoltaic (TPV) energy-conversion systems. Two types of customized GaAs cells were grown on intrinsic or semi-insulating GaAs substrates with either p-type GaAs or Al(.9) Ga (.1) As stop-etch layers. Holes were drilled through the substrate using a laser photochemical etch technique. Cells with high IR reflectivity and low series resistance were fabricated by drilling a hole which stopped at the contact layer of the cell with the Al(.9) Ga(.1) As stop-etch layer and then depositing gold in the hole and on the back surface. Measurements of these customized cells indicate that IR reflectivities in excess of 90%, corresponding to TPV efficiencies in excess of 35%, are feasible.

21237 (AD-A—186904/9/XAB) **Forward-biased current annealing of radiation-damaged gallium arsenide and silicon solar cells. Master's thesis.** Staats, R.L. (Naval Postgraduate School, Monterey, CA (USA)). Sep 1987. 101p. NTIS, PC A06/MF A01.

Radiation-damaged gallium arsenide and silicon solar cells were annealed using a combination of thermal and forward-bias current-annealing techniques. These cells were annealed under varying current densities from 0.125 to 1.250 A/sq. cm.2 and at temperatures from 90 to 140 C. Gallium arsenide solar cells annealed at current densities from 0.250 to 0.750 A/sq. cm. 2. Attempts to anneal silicon solar cells failed to produce positive results at all current densities. The primary application of this research is to determine the feasibility of on-orbit annealing of a satellite's solar array. At present, only silicon solar cells are deployed in space to provide electric power for satellites. When GaAs solar cells become space-qualified, on-orbit forward-bias current-annealing of these solar arrays may significantly increase the end of life of orbiting satellites.

21238 (AD-A—187156/5/XAB) **Solar-pumped, alkali-vapor laser. Final report, 1 September 1984-31 August 1986.** Ham, D.; DeFaccio, M.A. (Physical Sciences, Inc., Andover, MA (USA)). 4 Sep 1987. 58p. (PSI—118/TR-718). NTIS, PC A04/MF A01.

High-power lasers based in space have been considered as sources for power transmission, laser propulsion, materials processing, and space defense. The feasibility of such systems is based on the cost per unit power delivered, with detailed studies indicating that light weight has a greater impact on cost than laser efficiency. Solar radiation is a natural source of power for these devices and two methods for conversion of solar radiation to laser radiation can be considered. An indirectly solar-pumped laser would first convert the solar radiation to electricity or longer-wavelength blackbody radiation which is then used to power the laser. A directly longer wavelength blackbody radiation which is then used to power the laser. A directly pumped solar laser would utilize a portion of the solar spectrum to directly pump the laser medium, eliminating the intervening step and substantially reducing the systems weight and complexity. Detailed comparisons showed a directly pumped laser with an overall efficiency of only 1.5% can compete with an indirectly energized solar laser with an overall efficiency of 10%. With this in mind, a concept for a directly solar-pumped laser was developed based on an alkali vapor (sodium) as the laser medium.

21239 (DOE/CH/10093—6, pp 9-11) **Eucalyptus plantations for energy production in Hawaii.** Crabb, T.B. (BioEnergy Development Corp., Hilo, HI). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

There exists in Hawaii an urgent need for additional domestic energy sources to reduce dependence on imported oil and to supplement existing supplies of biomass fuel. This project is designed to develop information on the economic and technical feasibility of using eucalpytus trees for energy farming in Hawaii and similar subtopical regions, through field research into methods to increase productivity, development of optimal cultivation practices and harvesting methods, as well as evaluation of the associated costs of the complete system from production through conversion. Eighty-nine major research experiments were installed both at the nursery and in fields to evaluate species, spacing, nutrients (type, amount, and placement), herbicides, legumes, media, and other procedures for the express purpose of developing optimum cultivation practices. These tests are performed in both the Hilo and Ka'u areas and, in many instances, duplicated on different soil types. Forty-one are still in progress. In general, it was concluded that essentially all types of rubber-tired machines cannot operate successfully on the fragile and wet soils and shallow soil mat on Hawaii. BioEnergy's best short-run opportunity to conduct harvesting research and demonstration trials is to modify currently owned sugar cane harvesting machines, which have proven operability. Harvesting studies using conventional logging equipment gave preliminary costs of about $10 per green ton but did not leave the areas in very good condition for regeneration by coppicing. Studies have also been initiated to investigate the economic returns from biomass and plantations of eucalyptus in Hawaii. An analysis using a harvesting cost of $10 per green ton, and late 1985-early 1986 alternative energy costs for fuel oil and coal, gave after-tax rates of return of 26% on the best agricultural land and 8% to 11% on forest land and waste land.

21240 (DOE/CH/10093—6, pp 12-13) **Species screening and genetic selection at sites in Arizona, New Mexico, and Texas.** Kirmse, R.D. (Energy/Development International, Washington, DC). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

Fast-growing trees and shrubs potentially represent both a source of biomass energy and an economically superior use of marginal farm and range lands of the southwest US. Also, new fast-growing sources of fuel wood could ease pressures on slow-growing pinyon pines, currently a principal source of fuel wood for domestic use in New Mexico. The objectives of this project are to screen and select fast-growing species and to identify and develop related cultural and management practices as a basis for economically viable rain-fed bioenergy plantations in the southwest US. The first three research sites were planted in Arizona, New Mexico, and Texas. Data collection and analysis on survival and growth were completed as planned. Site management is ongoing. A total of 26 species have been screened to date. Results are not discussed.

21241 (DOE/CH/10093—6, pp 16-17) **Great Plains energy forest.** Geyer, W.A. (Kansas State Univ., Manhattan). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

The objective of this project is to determine biomass yield, financial and energy cost, herbicide toxicity, and feasibility of the multicoppice technique of selected hardwood species adaptable to short-rotation management schemes for fuel wood production in the central Great Plains area. Eighteen field plantings have been established throughout Kansas. Plantation ages run from 3 to 11 years. Highest biomass yields are black locust (eastern and central Kansas) and Siberian elm (central and western Kansas). Cottonwood grows well on eastern alluvial sites. Silver maple rates high because of a good yield and prolific and sustained sprouting capability, 6.7 to 13.5 Mg/ha-yr at 5 to 6 years. Black locust breaks up at 5 years due to borer damage. Basic tree size/yield regression equations have been calculated for the above ground oven-dry weight of 10 species having potential use in the short-rotation concept - only honey locust remains to be sampled and calculated. A major harvest operation was conducted in March 1985 on their operational energy forest at Sunflower. Costs and delivery to a site 113 miles away were $5.04/million Btu for maple; natural gas costs $5.40. Six new coppice studies were established in 1985 - silver maple, black locust, cottonwood, and Siberian elm. Weed control, fertilizer, time of year, stump treatment, and stump height are being tested. Ages run from 2 to 8 years. A coppice response list has been generated for 10 species.

21242 (DOE/CH/10093—6, pp 20-22) **Silvicultural and harvesting systems for producing fuels from woody biomass in the Southeastern United States.** Frederick, D.J. (North Carolina State Univ., Raleigh). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

The Southeast has great potential for producing large amounts of woody biomass for energy under short-rotation intensive culture (SRIC). Favorable climate, land availability, and proximity to users, plus a variety of potential plantation species, all contribute to good opportunities for high and sustained renewable biomass production. The objectives of this program are to: evaluate different silvicultural systems for short-rotation woody crop production and determine seedling and coppice production under a variety of plantation conditions; harvest energy plantations and determine yields, costs, and efficiency; establish and maintain an operational 15-ha sweetgum energy plantation in eastern North Carolina; initiate detailed coppice studies to evaluate the effects of silvicultural systems, stump height, stand age, and other variable on coppice productivity; and apply genetic and breeding programs to develop and propagate superior trees for short-rotation woody crops production. Seven-year yields in two North Carolina plantations have been reported and conclusions made. Close spacings (0.75 x 1.5 m) continue to give highest yields. Best species are sweetgum, sycamore, and European black alder on the red river bottom land sites and loblolly pine on uplands. Cottonwood gave best coppice yields on the bottom land. Recommended rotation ages are 8+ years. Nutrient evaluations indicate that bottom land sites are more susceptible to depletion following intensive harvesting and multiple rotations. Results for harvesting a 2-ha, 4-year-old sycamore plantation with a prototype harvester showed a total yield of 80.1 green tons and highest machine productivity with a 2.8-m within-row tree spacing, which resulted in a production rate of 1195 trees/h. Two-year-old sycamore coppice was harvested at a rate of 990 clumps/h for a production rate of 8.4 tons/h. Future efforts are described. 20 references.

21243 (DOE/CH/10093—6, pp 23-24) **Optimum nitrogen nutrition project.** Johnson, D.W. (Oak Ridge National Lab., TN). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW. Contract AC05-84OR21400.

In Biofuels and municipal waste technology research program summary: FY 1986.

The objective of this study is to evaluate the optimum nitrogen fertilization regime in short-rotation sycamore plantations. Optimum is defined in a variety of ways, including optimum growth response, optimum nitrogen retention (i.e., minimum nitrate leaching), and physiological responses such as resistance to drought and pathogens. The major question is the degree to which undesirable side effects (such as nitrate pollution) can be minimized while biomass production is optimized by various nitrogen fertilization regimes. As a prelude to the establishment of the entire study (scheduled for the spring of 1987), a pilot study was established in the spring of 1986 in which adjacent 6 x 6 m blocks of newly planted sycamore were fertilized with 0, 50, 150, 250, and 450 kg/ha of urea-N combined with 0, 25, 75, 125, and 225 kg/ha of triple superphosphate P. It was anticipated that high rates of fertilization might (1) induce P deficiency or (2) cause burning or other temporary damage to seedlings, and the pilot study was designed to address these issues before committing to the full study design. In addition, techniques for (1) tissue analysis for physiological properties, (2) estimating soil N availability and nitrification potential, (3) root sampling, and (4) mycorrhizal sampling are being evaluated in the pilot phase. A new method of monitoring root development with clear-walled plastic wells and video cameras is being tested and shows promise as a replacement for the traditional, very tedious excavation methods in some instances. Finally, preliminary results of a simplified procedure for obtaining nitrogen content in soil microbial biomass and nitrification potential in soil are showing promise and will likely be employed in the full study.

21244 (DOE/CH/10093—6, pp 26-27) **Economic analyses for producing Populus hybrid under four management strategies.** Blankenhorn, P.R. (Pennsylvania State Univ., University Park). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

Plantations have been established, harvested after the first rotation, and are operational on two sites. Energy and financial cost data for establishment and yearly fertilization and irrigation treatments are being monitored as inputs to the linear programming model. Biomass growth and production values for ages 1, 2, 3, and 4 years of the first rotation have been collected and are being analyzed. Second-rotation production data are being estimated on a subset of the study trees for coppice ages 1, 2, and 3 years. Biomass production values at the end of the second 4-year rotation will be determined for all trees. Fuel and chemical properties for wood, bark, and wood/bark specimens for the first rotation have been determined and analyzed. The linear programming model has been established and has been used to analyze the management costs, on a financial and energy basis, associated with the first 4-year rotation and the probably financial and energy output from this rotation. The linear programming model will be used to analyze selected management strategies for two rotations.

21245 (DOE/CH/10093—6, pp 29-30) **Biomass harvesting and field handling.** Curtin, D.T. (Tennessee Valley Authority, Muscle Shoals, AL). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

Harvesting technology for short-rotation intensive culture (SRIC) biomass is viewed as being a major limiting factor to the development and implementation of SRIC systems in the near future. A catalog of all likely machines (production, prototype, and documented conceptual) applicable to SRIC plantations was compiled. Relationships between biomass material characteristics and machine design specifications are being developed. Based on the relationships identified, several machine or system options were selected for evaluation. Evaluation will be based on technical soundness, productivity, cost-effectiveness, and other criteria. Field confirmation will be made. Recommendations will be formulated for future development, testing, construction, and/or demonstration of selected machines or systems (less than four machines).

21246 (DOE/CH/10093—6, pp 39-40) **Eucalyptus plantations for energy production in Hawaii.** Whitesell, C.D. (Forest Service, Berkeley, CA). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW. Contract AI05-86OR21661.

In Biofuels and municipal waste technology research program summary: FY 1986.

There exists in Hawaii an urgent need for additional domestic energy sources to reduce dependence on imported oil and to supplement existing supplies of biomass fuel. The project is designed to provide information on the economic and technical feasibility of using eucalyptus trees for energy farming in Hawaii and similar subtropical regions, through analysis of field research into methods to increase productivity, development of optimal cultivation practices and harvesting methods, as well as evaluation of the associated costs of the complete system from production through conversion. The approach is to analyze results of field research plots of eucalyptus trees that were used to conduct research in the areas of silviculture, engineering, and economics. The final product would be a series of reports on a renewable alternative source of fuel in the form of wood chips.

21247 (DOE/CH/10093—6, pp 41-42) **Woody species for biomass production in Florida.** Rockwood, D.L. (Univ. of Florida, Gainesville). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

A seedling seed orchard of E. grandis developed with more than 1700 trees on 17 ha can produce seed for over 100 million seedlings annually. Seed collected from the 50 best trees in the orchard could increase productivity by as much as 50%. Three E. grandis clones are frost-resilient and rapid growing in one clonal test. Additional clonal candidates have been monumented in commercial plantations. Preliminary investigations of embryogenesis in E. grandis are encouraging. Sources of E. camaldulensis show

promise for central Florida conditions, and four frost-hardy, vigorous clones were propagated. For northern Florida, E. amplifolia has good frost resilience; new accessions of the species may provide necessary cold hardiness. Propagation of E. amplifolia by rooted cuttings may be enhanced by regulator treatments and appears to have a genetic component. Estimates of E. amplifolia coppice productivity are as high as 23 Mg/ha-yr, and the species remains vigorous in a third coppice rotation. Two coppicing studies with genetic, spacing, harvest date, and rotation length components are developing well in southern Florida; individual E. grandis trees growing on organic soil were over 8 m tall after 12 months. Economic/energetic models for three eucalypt biomass systems were updated and suggested that E. grandis and E. amplifolia grown on appropriate sites can produce biomass at costs of approximately $2/GJ. Time and motion studies of the Bell Harvester used for developing the E. grandis orchard provided additional estimates of harvesting costs. Wood samples from trees harvested in the orchard were collected to evaluate genetic variability and age effects for biomass quality. Slash and sand pines through 6 years responded to fertilization, spacing, and genetic options for intensive culture. Casurina species may be suitable for biomass production in Florida.

21248 (DOE/CH/10093—6, pp 46) **Selection of herbaceous species for energy crops for the Southeastern United States.** Ward, C.Y. (Auburn Univ., AL). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

Lignocellulosic herbaceous energy crops are a renewable resource that can be used to provide liquid, gaseous, and solid fuels. From the large range of species available, appropriate species for different regions and site types must be selected so that cost-effective herbaceous energy feedstocks can be produced in an environmentally sound manner. Seven grasses (four perennial and three annual) and six legumes are grown either alone or in combination on four sites in Alabama. The legumes are primarily used as winter components of a double-cropping system. Yields of summer annuals were as high as 25.6 Mg/ha (11.4 tons/acre). At some sites, because of droughty conditions, establishment of perennials has been poor. Johnson grass yielded an impressive 10.8 Mg/ha (4.8 tons/acre) in its establishment year.

21249 (DOE/CH/10093—6, pp 47-48) **Screening and selection of herbaceous species for biomass production in the Midwest-Lake states.** Fick, G.W. (Cornell Univ., Ithaca, NY). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

Production of herbaceous plants for biomass energy must be evaluated in terms of climate, soil, and crops. Modern, computer-based, geographical information systems are being used to identify climate and soil combinations especially suited for herbaceous biomass. Computer simulation of crop growth is being developed and tested from field trials with potential biomass crops in order to predict yields and chemical characteristics of biomass from a wide range of climates, soils, and edaphic conditions. Nine field experiments to assess the biomass production potential of several herbaceous species are under way; a timothy-redtop red clover mixture grown at all sites had production ranging from 3.5 to 8.0 Mg/ha. Alfalfa-bromegrass yielded as high as 9.0 Mg/ha dry matter, while the highest yields of sudangrass were 9700 kg dry matter/ha. Flatpea and switchgrass were slow in establishment, and dry matter production ranged from less than 1.0 to 5.4 Mg/ha at the best site. The highest dry matter production of any crop was achieved with annual kale, which reached 11.6 Mg/ha. Old meadow sites were reasonably productive with adequate fertilization, chiefly with P and K, and reach yield levels of 6.1 Mg/ha at one site. Without adequate plant nutrients, however, yield levels of 2.0 Mg/ha only were achieved.

21250 (DOE/CH/10093—6, pp 49) **Screening of herbaceous species for energy.** Wright, N. (Geophyta, Vickery, OH). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

The main task to accomplish the project objective is to conduct a multiyear production experiment to evaluate 10 promising herbaceous species under two levels of weed control, two levels of fertility, and three levels of soil water drainage. An additional factor of harvest frequency is included under the highest level of drainage. Phase I involves establishment of these species by conventional tillage methods. Phase II will involve no-till establishment of species. A subtask of the above is to monitor soil nutrient removal by elemental analysis of harvested biomass. Additionally, structural and nonstructural cellular components will be determined on this biomass to indicate its desirability as an energy feedstock. Establishment of perennial species is nearing completion at each of the three research sites. Problems associated with establishment of lignocellulosic crops on chronically wet soils were identified. In general, slowly emerging species were more susceptible to being trapped in the surface crust that forms when clay soils following heavy rains. Fall-planted crops with slowly developing root systems must be planted earlier on wet soils to reduce the impact of frost heaving on winter survival. Results also indicate that minimum or no-tillage establishment methods may be preferable to conventional tillage methods.

21251 (DOE/CH/10093—6, pp 50-51) **Hydrocarbons from plants.** Calvin, M. (Lawrence Berkeley Lab., CA). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

The overall objective is to further the understanding of processes involved in control of plant hydrocarbon biosynthesis so that the systems can be manipulated to substantially increase hydrocarbon yields. Euphorbia lathyrus was the plant chosen as the model system. Environmental stresses have been applied in order to alter patterns of photosynthate allocation. Both salinity and water stress have been found to reduce growth before affecting photosynthetic yields, so it should be possible to alter demands for carbon without changing its availability. Thus, applied stresses can be used to study changes in carbon allocation to hydrocarbon synthesis and look for corresponding changes in the activities of the various enzymes or enzyme systems involved. To study regulation of hydrocarbon biosynthesis, isolated latex is used. Deuterated and radiolabelled precursors and a combination of TLC, HPLC, GC/MS, and NMR are used to study the individual reactions involved in isoprenoid biosynthesis. From this work the key steps in the biosynthetic pathway can be determined, and the enzymes responsible for the catalysis of these steps can be isolated for further study. To investigate the subcellular organization of latex, biosynthetic assays are combined with centrifugation and electron microscopy to assign a function to the various particles seen in latex. Either steam distillation or solvent extraction followed by analysis by GC, GC/MS, or NMR is used to screen additional species for hydrocarbon production potential.

21252 (DOE/CH/10093—6, pp 52) **Productivity of successional vegetation.** Johnston, J.W. (Oak Ridge National Lab., TN). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW. Contract AC05-84OR21400.

In Biofuels and municipal waste technology research program summary: FY 1986.

The objective of this research is to determine the productivity of successional vegetation that naturally invades abandoned croplands. Biomass and chemical yield responses of the successional species to fertilizers and harvest frequencies will be determined. Plots were established at two sites on the Oak Ridge National Environmental Research Park, Roane County, Tennessee. One was in an abandoned field previously used for soybean, winter wheat, and sorghum X sudangrass crops that was abandoned after the 1984 growing season. The other site was located in pasture maintained by mowing at 3- to 6-year intervals, primarily to keep out woody vegetation. Each site was divided into four blocks, each of which contained eight 3.1 m^2 plots. Two harvests frequencies and four nutrient treatments were randomly assigned to plots in each block. The abandoned soybean field, which is in a very early successional stage, is dominated by annual composites, while the abandoned pasture site is dominated by perennial grasses and invading woody vegetation. Treatments have been applied, and samples from the

first growing season have been collected and sorted. Information on biomass and chemical yields are forthcoming.

21253 (DOE/CH/10093—6, pp 53-54) **Evaluation of potential herbaceous biomass crops for marginal land.** Cherney, J.H. (Purdue Univ., West Lafayette, IN). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

The objective of this project is to evaluate the agronomic and economic feasibility of several management systems for producing herbaceous biomass on marginal croplands. The overall objective has been divided into four specific objectives. (1) The cool-season grasses (tall fescue and reed canarygrass) and the warm-season grass (switchgrass) are being evaluated at three marginal and one good agricultural site. Low-to-moderate amounts of nitrogen fertilizer are being applied, and stands are being harvested infrequently. (2) A continuous double-cropping system involving winter rye and sorghum X sudangrass or sweet sorghum is being investigated at four locations. (3) The possibility of seeding sorghum into recently harvested stands of cool-season grasses (tall fescue and reed canarygrass) with or without the aid of herbicides is being investigated. (4) Models are being developed to evaluate the economic feasibility of herbaceous biomass production. Preliminary results are given.

21254 (DOE/CH/10093—6, pp 61-62) **Wetland herbaceous biomass production.** Pratt, D.C. (Univ. of Minnesota, St. Paul). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

The objective of this project is to develop a technical information base of sustainable productivity levels under various management scenarios and site conditions for several species of the emergent aquatic Typha plant - a ubiquitous, highly productive, perennial plant in the US. Five tasks were defined: (1) initiation of field experiments to assess the productivity of Typha species under three harvesting scenarios, (2) evaluation of irrigation requirements for Typha species under both laboratory and field conditions, (3) determination of an acceptable soil pH range for the cultivation of Typha, (4) development of an understanding of how flowering affects productivity and how flowering might be controlled if it is found to affect productivity, and (5) development of an understanding of the factors affecting the ratio of above ground to below ground biomass, since approximately half of Typha biomass is located in a below ground rhizome system. The status of each task is discussed.

21255 (DOE/CH/10093—6, pp 63-64) **Perennial species for optimum production of herbaceous biomass in the Piedmont.** Parrish, D.J. (Virginia Polytechnic Institute and State Univ., Blacksburg). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

This research endeavors to examine (1) what makes some cropland marginal, (2) which species might be the best energy crops on such land, and (3) what it costs to produce biomass on such land. These goals can be further detailed as follows: (1) characterize typical marginal sites in the Piedmont of Virginia regarding their soil properties, (2) compare several herbaceous species in biomass production on such marginal sites, and (3) determine the costs of establishment and production for energy crop candidates on these marginal sites. Each of 12 study sites representing three major Piedmont soils (Appling, Cecil, and Davidson) will be characterized morphologically, chemically, and physically. Seven perennial and one annual herbaceous species will be no-till planted and evaluated for biomass yield. The energy crop candidates include four grasses and four legumes: tall fescue (Festuca arundinacea), weeping lovegrass (Eragrostis curvula), switchgrass (Panicum virgatum), sorghum-sudangrass (Sorghum bicolor X sudanense), crownvetch (Coronilla varia), sericea lespedeza (Lespedeza cuneata), birdsfoot trefoil (Lotus corniculatus), and flatpea (Lathyrus sylvestris). All field phases of the soil analysis at the 12 marginal study sites have been completed, and the laboratory analysis is nearing completion. Some preliminary results are given on plant productivity.

21256 (DOE/CH/10093—6, pp 78) **Evaluation of available saline resources in New Mexico for the production of microalgae.** Lansford, R.R. (New Mexico State Univ., Las Cruces). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

The major objective is to develop a more detailed assessment on the availability of saline water in New Mexico as it relates to the establishment of microalgae production technologies. Specific objectives are to (1) define areas within the State of New Mexico with saline aquifers with average depths to ground water of less than 500 ft; (2) determine those areas that would provide water yields of less than 4 million gallons/day, those areas of 4 to 13 million gallons/day, and those areas with yields greater than 13 million gallons/day; (3) define the chemical composition (major ions and nutrients) of the ground waters in areas; and (4) define possible environmental or legal constraints to the use of these saline water resources, including possible constraints due to land acquisition and siting. Identification of those geographical areas in New Mexico best suited to the use of saline waters for microalgae production will be accomplished by constructing a series of maps of New Mexico that meet the criteria specified above. The quality of the water resources identified will be assessed. This assessment will include total salinity and identification of major ions. Upon completion of these tasks, maps will be developed that identify those areas with the greatest possibilities for microalgae production. These maps will combine the above screening data via a computer coordinating system, and thermatic maps will be generated.

21257 (DOE/CH/10093—6, pp 89) **Inventory of sources of available saline waters for microalgae mass culture within the state of Arizona.** Wilson, L.G. (Univ. of Arizona, Tucson). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

The overall objective of this project is to develop a more detailed assessment of the availability of saline water in Arizona. The specific objectives include: (1) delineate areas within Arizona with saline aquifers at 250-500 ft depth (or deeper if economically feasible) or areas with large amounts of saline agricultural return waters; (2) establish real classifications according to less than 4 million, 4-13 million, and greater than 13 million gallons/day and estimate aquifer life at these depletion rates; (3) define the chemical composition (major ions and nutrients) of the waters that meet objectives according to the classification of 2; and (4) define possible environmental or legal constraints to the utilization of these saline water resources. Estimates were made of the resource base of saline water for microalgae culture and how much land has access to this water. Areas were then identified which would provide sufficient water to supply one or several 1000-ha microalgae facilities. The major ions (Na^+, Ca^{+2}, Mg^{+2}, K^+, Cl^-, HCO_3^-, CO_3^{-2}, SO_4^{-2}) and nutrients (nitrogen and phosphorus) were defined for water sources identified. Finally, the potential political, economic, and environmental constraints to the utilization of saline water resources in Arizona were also defined.

21258 (DOE/CH/10093—6, pp 91) **Productivity optimization of saline microalgae growth in outdoor mass culture.** Laws, E.A. (Univ. of Hawaii at Manoa, Honolulu). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

The overall objective of this project is to improve the technology of outdoor culture of microalgae for the production of oils by the investigation of species/strains, optimization of culture conditions, and development of culture strategies that increase cost efficiency and improve yields. Promising candidate species were screened in four 9-m^2 flumes for suitability in outdoor mass culture and for the ability to store nutrients when nutrient stressed. A laboratory-scale study was run to determine the relationship between biomass production and dilution interval, time of day of harvest, and biomass concentration immediately after harvest.

21259 (DOE/CH/10093—6, pp 92-93) **Collection of high energy yielding strains of saline microalgae from the Hawaiian Islands.** York, R. (Univ. of Hawaii at Manoa, Honolulu). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

The main objective of this research is to identify strains of microalgae that will be productive in outdoor mass cultures operated for the production of fuels. The production rates of the most promising clones collected during year one under conditions simulating those expected in production-scale facilities were compared. Culture vessels were constructed of Aclar plastic in order to allow the penetration of full-spectrum solar irradiation. The 20 most productive clones will be tested for growth rate and production responses to culture density, dissolved oxygen concentration, pH, salinity, solar ultraviolet irradiance, temperature, and water type. Interactions of culture variables on growth rate and production of microalgae will be determined. The characteristics of the collection sites from which the most desirable clones are isolated will be described. In addition, the effects of solar ultraviolet irradiance on lipid production will be determined.

21260 (DOE/CH/10093—6, pp 211) **State technical assistance grant [Alaska].** Woodell, P.L. (Alaska Power Authority, Anchorage). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

Six on-going core functions are performed by the states as part of their involvement in the Pacific Northwest and Alaska Bioenergy Program. They are (1) participate in Policy Group and Task Force meetings and related activities; (2) prepare state annual operating plans and multi-year programs; (3) implement interagency coordination of program and resource development activities on the state level; (4) serve as a focal point for biomass energy system applications information technology transfer to the public, legislators, private industry, and local agencies and government; (5) prepare assessments of potential biomass-fueled targets of opportunity within the state's industrial, commercial, and public institution sectors; and (6) develop and provide an annual update of available state biomass resource base. A state operating plan has been adopted, which identified six key issues and actions for the promotion of biomass development. These issues, the focus of the office's work, include (1) promote the expansion of the timber industry to increase the supply of residue for fuel use, (2) develop an inventory of the state's resource base, (3) promote biomass use in state and federal facilities, (4) promote fuel recovery techniques in land clearing operations and agricultural development operations, (5) promote residential wood use in wooded areas, and (6) support infrastructure and timber industry development.

21261 (DOE/CH/10093—6, pp 213) **Regional forest residue supply curves.** Tillman, D.A. (Envirosphere Co., Bellevue, WA). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW. Contract AC79-83BP18507.

In Biofuels and municipal waste technology research program summary: FY 1986.

In-woods marginal cost curves were developed for logging residues for 84 counties in the Pacific Northwest. For southeast Alaska, an estimate for average cost was produced. A method was devised, because of the unlimited potential delivery points, that allows a user to estimate site-specific marginal cost curves for delivered material. Counties were identified by their potential for supplying large volumes of residue at the lowest cost. Four categories were used (based on the in-woods marginal cost plus a constant factor for in-woods chipping and hauling 50 miles): maximum potential, good potential, average potential, and less potential. Those counties with areas where the most timber harvesting occurs produce the best supply zones. The curves can be used to estimate the cost of fuel for the siting of a plant of a specific size or in selecting the best sized plant.

21262 (DOE/CH/10093—6, pp 214) **State technical assistance grant [Idaho].** Galinato, G.D. (Idaho Dept. of Water Resources, Boise). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW. Contract FG79-83BP35475.

In Biofuels and municipal waste technology research program summary: FY 1986.

Six on-going core functions are performed by the states as part of their involvement in the Pacific Northwest and Alaska Bioenergy Program. They are (1) participate in Policy Group and Task Force meetings, and related activities; (2) prepare state annual operating plans and multi-year programs; (3) implement interagency coordination of program and resource development activities on the state level; (4) serve as a focal point for biomass energy system applications information technology transfer to the public, legislators, private industry, and local agencies and government; (5) prepare assessments of potential biomass-fueled targets of opportunity within the state's industrial, commercial, and public institution sectors; and (6) develop and provide an annual update of available state biomass resource base. Work has been directed at the development of the following: (1) an inventory of biomass resource end users, (2) an assessment of potential targets to use biomass resources, (3) a permitting handbook for bioenergy projects, and (4) a resource assessment compilation.

21263 (DOE/CH/10093—6, pp 217) **State technical assistance grant [Montana].** Haines, H.E. (Montana Dept. of Natural Resources & Conservation, Helena). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

Six on-going core functions are performed by the states as part of their involvement in the Pacific Northwest and Alaska Bioenergy Program. They are (1) participate in Policy Group and Task Force meetings and related activities; (2) prepare state annual operating plans and multi-year programs; (3) implement interagency coordination of program and resource development activities on the state level; (4) serve as a focal point for biomass energy system applications information technology transfer to the public, legislators, private industry, and local agencies and government; (5) prepare assessments of potential biomass-fueled targets of opportunity within the state's industrial, commercial, and public institution sectors; and (6) develop and provide an annual update of available state biomass resource base. Bioenergy efforts in Montana have been focused on the following: (1) preparation of a two year operating plan; (2) preparation of a biomass handbook on Montana's siting, construction, and environmental permit system for bioenergy projects; (3) development of an inventory of industrial and commercial boilers; and (4) assessment of potential biomass fuel targets of opportunity within the industrial, commercial, and public institution sectors.

21264 **(DOE/ER/10745—4) Charge separation in photoredox reactions: Technical progress report, May 1, 1984-May 1, 1987.** Kevan, L. (Houston Univ., TX (USA). Dept. of Chemistry). 1 May 1987. Contract AS05-80ER10745. 51p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88006069/JAW.

Structural aspects controlling charge separation in molecular photoionization reactions in organized molecular assemblies involving micelles and vesicles are being studied by optical and electron magnetic resonance techniques including the time domain technique of electron spin echo modulation (ESEM). Photoionization of N,N,N',N'-tetramethylbenzidine (TMB) to give the cation radical has served as a useful probe reaction. The photoionization process has been studied in detail in both anionic and cationic micelles. Cation-water interactions have been detected by ESEM analysis and have been used to assess the effects of added alcohol cosurfactants on the photoionization efficiency. x-Doxylstearic acid spin probes have been used to determine the effect of various micellar surface modifications on the surface and internal micellar structure and the relation of these structural changes to the photoionization process. The structure of microemulsion systems has been studied with doxyl nitroxide probes. Photoionization of chlorophyll has been studied in dipalmitoylphosphatidyl choline vesicles and direct photoionization in the absence of added electron acceptors has been

found in frozen solutions. Decay kinetics of TMB cations in micelles have been interpreted in terms of a time dependent rate constant. 34 refs., 1 fig.

21265 **(DOE/ER/10878—T4) Conversion of cellulose to ethanol by mesophilic bacteria: Final report, July 15, 1984-November 14, 1987.** Canale-Parola, E.; Dowell, C.E.; Leschine, S.B. (Massachusetts Univ., Amherst (USA)). Jan 1988. Contract AC02-81ER10878. 12p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88006017/JAW.

The physiology and genetics of mesophilic cellulose-fermenting, ethanol-producing bacteria were investigated in order to develop strains of bacteria that can be used in the conversion of biomass materials to ethanol. Studies involved, primarily, a species of Clostridium (strain C7) isolated from the sediment of a freshwater swamp. A cellulose-fermenting bacterium from wetwood and several strains of nitrogen-fixing cellulose-fermenting bacteria from soil were also investigated. As a first step to understanding the genetic organization of the cellulase system of these bacteria, enzymes associated with the hydrolysis of cellulosic materials by strain C7 were characterized. Crystalline cellulose was solubilized by a 700,000 molecular weight complex comprised of approximately 18 polypeptides. This complex was required in its entirety to degrade crystalline cellulose, inasmuch as this activity was lost when the complex was disrupted into its constituent proteins. Studies involving a cellulase-deficient mutant supported this conclusion. Other enzymes that were investigated included β-glucosidase and cellobiose phosphorylase. Also, a strain C7 gene encoding β-xylosidase was cloned in E. coli. Enzyme purified from E. coli cells containing the cloned clostridial gene had a molecular weight of 240,000. A bacteriophage of strain C7 was isolated and characterized, and methods for forming protoplasts and regenerating cell walls of strain C7 were developed. 10 refs.

21266 **(EUR—9950) Studies on improvement of ouput from CdS/sub spray/-Cu/sub 2/ S photocells.** Vedel, J.; Lahaye, J.; Martinuzzi, S.; Bougnot, J.; Cadene, M.; Bordure, G.; Savelli, M. (Commission of the European Communities, Luxembourg). 1985. 114p. (In French). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88752281/JAW.

The preparation of backwall structures of Cu/sub 2/ S-CdS by means of pulverization is described within the framework of a study on a pilot installation. A homogeneous deposit has been obtained on a surface of 100m/sup 2/ and non-encapsulated cellules of 1 cm/sup 2/ surface have provided a mean statistical yield of 6% for an output of energy of 100 mW per cm/sup 2/, the best result obtained being 8%. Tests of stability are described.

21267 **(EUR—11136) Bioenergy: European Research and Development: Contractors' catalogue.** Grassi, G.; Caratti, G. (eds.). (Commission of the European Communities, Brussels (Belgium)). 1987. 179p. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88900400/JAW.

This catalog contains two-page summaries of the results obtained in the contracts on energy from biomass which were concluded between the Commission of the European Communities, Directorate-General XII: Science, Research and Development, Brussels, and a number of public and private research institutions in the European Community.

21268 **(N—88-14493) Design, fabrication and delivery of a miniature Cassegrainian concentrator solar array system. Final technical report.** Kruer, M.A. (TRW Defense and Space Systems Group, Redondo Beach, CA (USA)). Oct 1987. 220p. (NASA-CR—179237; NAS—1.26:179237; REPT—45050-6001-UT-001). NTIS, PC A10/MF A01.

The optical design of the miniature Cassegrainian concentrator (MCC) element was improved for both offpoint and onpoint power capability. The cell stack design has shown no losses under the high short term thermal stresses imposed by component level test and is projected to be capable of greater than five years thermal cycle life in low Earth orbit. The structural design met all requirements for stiffness and flatness and requires adjustable inserts for fine tuning of the GFRP structure to meet flatness goals. The completed, fully populated small and large MCC panels deliverable under this contract perform electrically as expected. A solid acceptance inspection program to guarantee quality of all purchased parts, and continued manufacturing process improvements will make the MCC design a viable low cost alternative to standard flat panel technology. Minor improvements to the cell stack design of the MCC element can make significant improvements in both the performance and manufacturability of the MCC system.

21269 (NEDOJ—8401, pp 215-220) **Verification on purification of low-cost silicon for photovoltaic power generation. Development of chlorosilane production technology.** Aug 1984. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770050/JAW.

In FY 1983 NEDO Annual Report.

This is a report for the year of 1983 on the study of development of producing technology of low cost chlorosilane (TSC) in connection with development of low cost refining process of silicon for solar cells. 1. Undergoing of government tests; Prior to operation of experimental equipment (in a TCS 200t/ year) so far installed before 1982, government tests were executed on pressure containers, tanks for products, distillation equipments, etc. 2. Operation study and element study; Operation study was conducted over eight items including continuous operation for 30 days (total 3000 hours). As a result, it was confirmed that refining of TCS in 200t/year scale is well attainable. On the other hand, a preliminary test for feeding hydrogen chloride gas into a conversion furnace was conducted as an element study. However, no conclusion was obtained. 3. Evaluation of TCS quality and feeding to the next process; Approximately 70t of TCS (14 lots) obtained by the operation study were fed to the next process. For quality evaluation, polycrystalline silicon was produced from TSC to measure specific resistance by making it a single crystal. The value obtained from the measurement cleared the provisional standards.

21270 (NEDOJ—8401, pp 221-225) **Verification on purification of low-cost silicon for photovoltaic power generation. Development of hydrogen reduction of chlorosilane.** Aug 1984. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770050/JAW.

In FY 1983 NEDO Annual Report.

This is a report for the year of 1983 on the study of development of technology for hydrogen reduction process of chlorosilane in connection with development of low cost production process of silicon for solar cell. Operation study was mede over ten times with an experimental equipment in a 10t range to produce 4,298kg silicon granule. Electric power unit showed 31.9KWH/kg Si, a value close to that in the initial plan. However, Si yield was less than that in the planned value of 20%. As to an experimental equipment for material production, operation of a roll crusher was executed to crush 857kg Si in total with total crushing hour of 92hr. Abrasion degree of silicon rolls was approximately 1g per 1kg crushing amount. Required frequency of roll cylinder grinding was one time per crushing amount of approximately 200kh. In view of the poor property of an outer tube made of quarz, a reaction equipment not utilizing a quarz tube was examined, while equipping a radiation thermometer to the reaction equipment. Meanwhile, improvement and standardization of an ICP spectro-photometer was examined.

21271 (NEDOJ—8401, pp 226-230) **Verification on experimental production of solar panel for photovoltaic power generation. Development of cast substrate production process.** Aug 1984. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770050/JAW.

In FY 1983 NEDO Annual Report.

With respect to technology of polycrystal silicon ingot casting, adjustments were made to the experimental manufacturing device and the casting conditions of granule SOG-Si which was supplied from the proceeding process were examined. 1) Conformity with the proceeding and succeeding processes--- In comparison with lump SEG-Si, granule SOG-Si is less soluble and needs longer heating. Concequently painted parting media excoriate, thus causing ingot cracks. This problem was solved by adding granule SOG -Si to fused silicon which had been formed beforehand by using soluble lump silicon. Concerning the excoriation of parting media due to gas which is produced during the heating process, it was solved by changing the vender. Cracking due to dissoluble objects during the

stage of cooling and solidification was solved by dispersing such objects through controlling the heating conditions of fused silicon. The disconformity problem occurred with the succeeding process, but it was solved by checking the conditions of advancing wires of a multi-wire saw and supplying slightly thicker wafers. 2) Operation study--- The target was the amount equivalent to 15 KWP of solar cell panels and about 40,000 wafers were supplied to the succeeding process. (1 fig)

21272 (NEDOJ—8401, pp 231-235) **Verification on experimental production of solar panel for photovoltaic power generation. Silicon ribbon wafer process technology.** Aug 1984. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770050/JAW.

In FY 1983 NEDO Annual Report.

Development of ribbon cristal base plate process technology was pursued. 1) Adjustment operation--- Each of the following devices was adjusted and the oeration research started: a) Ribbon cristal base plate lifting unit, b) Device of slicing at the predetermined dimensions, c) Annealing furnace,d) Automatic etching device, e) Electrical characteristics tester, and f) Configuration characteristics tester. 2) Operation research--- a) Improvement of durability of ribbon lifting device ; When the experimental production machine was operated continuously for a long period, water leakage occurred in the chamber. This was solved by altering running water paths on the presumption that stress erosion due to continuous heating was the cause thereof. b) Improvement of duration of lifting ribbon cristal; In order to avoid interruption, temperature variation and lifting speed variation were checked. It was revealed that there is a reason for interruption of lifting with respect to granule silicon too. c) Improvement of the quality of ribbon cristal; Efforts were made for reducing the amount of residual impurities. For this, improvement of purity of carbon material inside the furnace and quartz for the crucible were both effective. Because of the foregoing, 20,000 ribbon cristal base plates were forwarded to the dry and wet PN junction processes. 3) Process improvement study--- In order to reduce density of slicon carbide of the surface of ribbon crystal, a trial of conforming capillary die with material other than carbon is now under way.

21273 (NEDOJ—8401, pp 236-239) **Verification on experimental production of solar panel for photovoltaic power generation. Dry PN junction process.** Aug 1984. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770050/JAW.

In FY 1983 NEDO Annual Report.

Development of dry PN junction process technology was pursued. As follows: 1) test operation study, 2) operation study and 3) improvement study are summerized; 1) Test operation study--- The following works were carried out; a) Technical assessment of the process concerned; Wafer handling, confirmation of manufacturing conditions and cell experiments using CZ wafers, and experiment of assessing connectability of leads. b) Assessment of cast cell; Handling of cast wafers, confirmation of manufacturing conditions and cell experiments using cast wafers. c) Assessment of ribbon cell, and d) Establishment of life-time measuring standard, etc.. 2) Operation study. a) Stabilization of the conditions concerning production line using SOG cast cells; It was confirmed that control of exact temperature and the inner atmosphere during the heat treatment process, and control of film thickness during the antireflection film forming process are the important items. b) SOB ribbon cell; Automatic operation became feasible, however it was confirmed that improvement of the surface condition of ribbon base plates and improvement of the facilities are necessary. 3) Examination of possible improvement of process; Improvement of cell characteristics, reduction of the number of unit process, increase of production speed and improvement of ion inputting device etc. were examined.

21274 (NEDOJ—8401, pp 240-245) **Verification on experimental production of solar panel for photovoltaic power generation. Wet PN junction process.** Aug 1984. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770050/JAW.

In FY 1983 NEDO Annual Report.

As a part of the Sunshine Project of the Ministry of International Trade and Industry, researches were made in order to reduce production costs of silicon solar cells. As the result, the technology of the wet PN junction process was developed. This new process alters significantly the existing production process of silicon solar cells which has been the obstacle against the reduction of production costs and also shortens the production time making low-cost production feasible. A pilot manufacturing line was constructed. This line is a manufacturing line of solar cell elements of various SPG-Si substrates and has the production capacity equivalent to 250 kWp per annum. Summary is shown as follows mainly on this experimental device; 1) This device consists of such units as for surface treatment, printing electrodes, side bonding and separation, and solder coating. When the device was adjusted and altered so that it may suit SOG (Solar Grade) substrates,it was found that continuous manufacture of elements for SOG substrates becomes fundamentally feasible. 2) Operation studies were made by using SOG cast substrates and SOG ribbon substrates and good results were obtained in terms of the characteristics of Solar Grade silicon substrates. As for SOG ribbon substrates, technologically problematical points were identified. 3) As one of the improvements of the process, an automatic storing device of substrates was provided between the diffusing device and the rear electrode printing process unit. (2 figs, 1 tab)

21275 (NEDOJ—8401, pp 246-255) **Verification on experimental production of solar panel for photovoltaic power generation. Technology development of panel assembling process.** Aug 1984. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770050/JAW.

In FY 1983 NEDO Annual Report.

As a part of the development of a mass and low-cost production line of solar cell panels, development of panel assembling process technology was pursued. An outline is shown as follows; 1) Research on cell aligning and connecting process--- The optimum conditions for aligning and connecting technology as well as facility system were determined and lead connecting technology was assessed. Setting of the lead connecting temperature profile, assessment of the cell electrode pattern and test operation research of SOG cast string etc. were performed. Furthermore operation researches were made on (1) SOG cast string, and (2) SOG ribbon string. It was confirmed that there is no problem with regard to the conditions of forming strings. 2) Research on panel packaging process--- Designs of the output terminal section and frame were altered. Since the assessment of the sealed bonding showed the superiority of EVA over PVB, design was changed to use EVA. Besides through test operations and operation research, EVA demonstrated the better result than PVB since the former has relatively low viscosity thus the occurrence of cell breaking is less. 3) Research on inspection process and plant system --- As the result, panelization of CZ, cast and ribbon was achieved. (1 fig)

21276 (NEDOJ—8401, pp 256-258) **Practical application of amorphous solar cells. Production technology for low-cost monosilane .** Aug 1984. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770050/JAW.

In FY 1983 NEDO Annual Report.

The objectives of the technological development of this project are the development and continuous operation of a 10 tons/year scale test production facility and the improvement of the processes for increasing productive capacity, to develop technology for practical application of low cost monosilane production system. In the study on monosilane production, the monosilane production chamber failed to show the expected capacity for a short period operation test. However, as to the rest of the planned subjects, achievement of the target capacity was found promising with the exception of minor field. Long continuous operational tests totaling 700 hours were carried out. The efficiency of monosilane production was as low as about 63% against electrolytic current. Study was made to solve problems, and the monosilane production test equipment was improved on the fused salt electrolysis reaction tank, production and supply of silicon tetrachloride, and electrolytic dissociation and refinement device of monosilane. For operation control and efficiency improvement, promotion of automation and improvement of efficiency were studied. As to the evaluation technology for monosilane, improvement in accuracy of impurity analysis and evaluation test relating produced monosilane were performed.

21277 (NEDOJ—8401, pp 259-267) **Practical application of amorphous solar cells. High quality production technology.** Aug 1984. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770050/JAW.

In FY 1983 NEDO Annual Report.

The targets of the project are to develop production technology of amorphous solar cells for electric power generation which will possess good reproducibility and be highly sensitive to solar light, and to elucidate their technological and economical applicability. During the years of from 1980 to 1982, studies on research and development of amorphous solar cells with multi-layer structure were made, and the conversion efficiency of the amorphous sollar cell was improved to 82.5% (10 cm square cell). (1) Amorphous growth equipment for continuous formation of tandem structure was designed and constructed. Boron concentration when grown in independent separate reaction chambers was found to be less than 1/10 of that grown in the single chanber. Film formation rate of 7° A/sec was achieved using Si_2H_6 for the growth of a-Si:H(i). (2) In the technology for stainless steel substrate modules, modules of the sizes specified by NEDO were assembled with the super strail structure employing tempered glass, achieving 4.7% conversion rate. (3) For materials and formation technology of the transparent conductive film grid electrode, light transmittance and resistance of the film made by sputtering evaporation of ITO film were studied. (4) As regards reliability technology, it was found that the tandem structure will greatly decreace the deterioration rate as compared with the single layer structure. The modules with super strait structre proved to be weatherproof. (4 figs)

21278 (NEDOJ—8401, pp 268-274) **Practical application of amorphous solar cells. Large area production technology.** Aug 1984. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770050/JAW.

In FY 1983 NEDO Annual Report.

Development of large size production technology using uniform cells with little defect for the establishment of technology for practical application of amorphous solar cells for power generation is the target of this project. In 1980, cells of stainless steel substrate type were made on a trial basis. In 1981, conversion efficiency of 7.8% (for 1.2 cm^2) and 7.6% (for 100 cm^2) were achieved in the improvement research work for cells. In 1982, a test facility for large size a-Si production was designed and constructed. (1) Research on film formation method of large size a-Si: Less than 10% film thickness and highly uniform film quality were obtained by using film formation device for the IVE type large size a-Si. The effect of oxygen on the film quality and the effect of continued exposure to light were studied. (2) Study on formation of large size and low cost transparent electrode: Experiment of SnO_2 film formation was performed. (3) Research on large size cells: Provision of a layer by carbon doping in the i layer close to the p/i boundary was found to be effective for the improvement of cell's characteristics. (4) Study of evaluation technology: Evaluation technology for structural defects of the a-Si film was studied. Factors and module production technology for the designing of structures using large size cells were also studied. As a result of a test for mechanical strength, the module meeting the NEDO standard and with no surface cover glass was found to be sufficlently strong. (6 figs)

21279 (NEDOJ—8401, pp 275-282) **Practical application of amorphous solar cells. Application of high productivity fabrication technology.** Aug 1984. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770050/JAW.

In FY 1983 NEDO Annual Report.

Development of high efficient and high speed production technology of amorphous solar cells for electric power generation and study on their technological and economical possibility are the objectives of this project. In the study of high speed film formation with monosilane, it was found that the speed of film formation could be increased with the increase in power and the amount of gas flow. As regards amorphous film formation with silane of higher orders, formation by separate system was found more effective than in the case with monosilane. As to the development of high efficient film formation technology, facilities were designed and constructed based on separate continuous formation system for p, i, and n layers. Characteristics of monosilane and silane of higher orders were studied, and three kinds of recovery methods were investigated. Laser patterning of TCO film was studied. In relation to the development of solar cell modules for power generation, conversion rates of over 10% for the small size element and 8% for the 10 cm square concentration type element were achieved.

21280 (NEDOJ—8401, pp 283-285) **Research for utilization of amorphous solar cells. Analysis for practical application.** Aug 1984. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770050/JAW.

In FY 1983 NEDO Annual Report.

To acquire technical information in Japan and foreign countries concerning amorphous solar cells and reflect it to and support the R/D activities for practical application of amorphous solar cells for power generation are the objectives of the project. For mass production of large size amorphous solar cells for power generation, there still exist some unsolved technological problems as follows: High speed film formation and higher film quality, Factors preventing large size cell production, Development of production technology for stable solar cells, Establishment of uniform and high yield continous automated processes, Simple methods for evaluation, Preparation technology and materials for low cost substrates, and, Development of application systems particular to amorphous solar cells. The report for this year summarized the results of studies set by the committee for the approach to the above problems, and could be said as an interim report. The subjects set for the studies are described in the Item 3: Details of technological development plan among which are: Possible costs towards the and of 1980, Technologies for high efficiency, resistance to deterioration, by heat, and high speed film formation, Market forecast viewed from the volume of demands, and, Study on research in foreign countries.

21281 (NEDOJ—8401, pp 286-290) **Research and development of evaluation system for solar cells.** Aug 1984. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770050/JAW.

In FY 1983 NEDO Annual Report.

Methods for evaluating the performance and reliability of solar cells were developed. The activities performed to develop the performance evaluation method include study for improvement on the devices developed to conduce standard calibration of solar cells and on the components of the main equipment for evaluating the performance of solar cell modules. They also include development of standard management technology and tests of various solar cell modules for their characteristics. The activities performed to develop the reliability evaluation method include exposure tests of various modules using a weather room and outdoor exposure test equipment and development of temperature-humidity cycle test equipment, salt spray test equipment, and SO_2 gas atmosphere test equipment for the purpose of developing a weather-proofness test system. The progress of this research and development is as follows: In 1980 and 1981, a large solar simulator was developed and utilized to study standard calibration technology, standard solar cell method, experiment methods concerning the temperature dependence, irradiance, and other characteristics of solar cell modules. In 1982, a weather room, outdoor exposure test equipment, and meteorological element measurement equipment were developed.

21282 (NEDOJ—8702, pp 7-11) **Low cost silicon purification experiment. Development of low cost triclorosilane manufacturing process.** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770076/JAW.

In FY 1986 NEDO Annual Report (Part 2).

Development of low cost triclorosilane (TCS) manufacturing process for solar cells was made in 1986. A TCS 200 tons / year pilot plant was continuously operated for 89 days successfully. For the impure residue ratio in the reaction furnace, SiO_2 was 27.3%, Fc 22.1%, and Al 7.5%. The impurities, having a fine-grain size, can be captured by a cyclone separator, and are not an obstacle to long period operation of the furnace. The carry-over ratio was 3 - 5% of the metal silicon (MG - Si) material charge. The TCS conversion ratio exceeded 98% for the pure Si, and was below 60 kg/TCS ton for the MG - Si material charge. A preferred catalyst was CuCl. Increase in reaction pressure resulted in enhancement of the conversion ratio at the equilibrium, and reduction in the reaction rate. Distillation process steam could be saved above 20%. Physical

properties of by-produced polychlorosilane were examined. A useful furnace material is SUS 316. (21 tabs)

21283 (NEDOJ—8702, pp 12-15) **Low cost silicon purification experiment. Low cost chlorosilane process development (Rapid quenching).** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770076/JAW.

In FY 1986 NEDO Annual Report (Part 2).

Development of process for low cost trichlorosilane (TCS) from silica through silicon tetrachloride (STC) was made in 1986. Addition of an organic binder to pelletized raw materials enhanced the strength of the pellets, which enables stable continuous operation of a granulating machine. Prevention of bridges from forming in the STC reaction furnace, and adoption of a cooling mechanism for the furnace material were effective for anti-corrosion of the furnace at high temperature. Troubles such as fine-powdering, closing of chlorides, etc. were eliminated. Long period stable operation of the STC reaction furnace at the crude STC yield of 92% can be expected. The structural improvement in the quenching zone, etc. contributed to the conversion ratio of STC to TCS exceeding 30%. A pre-heater was provided in the inlet of the furnace for energy saving. A distillation equipment for high boiling point substances generated in the furnace was effective to prevent closing in the furnace. TCS was recovered from circulated hydrogen gas through a deep-cooling condenser. The specific resistance and the life time of the synthesized TCS attained the goal of NEDO.

21284 (NEDOJ—8702, pp 16-20) **Low cost silicon purification experiment. Development of low cost chlorosilane production process production process for high purity silica and silicon.** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770076/JAW.

In FY 1986 NEDO Annual Report (Part 2).

Development of solar cell silicon manufacturing process from low-grade silicic sand through high-purity silica was made in 1986. The continuous automatic, mechanical purification of the silicic sand resulted in a purity above 99% (the material purity of 96 - 97%), though the purification required man-labor partially. The product was converted to a water-glass, followed by chemical purification. Both techniques of pulverization and crude granulation are available. For this continuous experiment, the crude granulation was employed. Powdery carbon for reduction was prepared from commercially-available propane gas. Clogging in the reaction furnace due to the resultant carbon was reduced by improvement in the cooling method. The improved unit prolonged the operation time to 38 hours. The Si purity was 99.5%. the goal of the Mg-Si was attained except for contamination of Fe, Ni tools. The removal of carbon from the Si required a combination of SiC removal pretreatment and pressure-reduction by SiO. (2 tabs)

21285 (NEDOJ—8702, pp 21-25) **Low cost silicon purification experiment. Chrosilane hydrogenation process.** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770076/JAW.

In FY 1986 NEDO Annual Report (Part 2).

Development of chlorosilane hydrogenation process in low cost solar cell silicon production was made in 1986. For a 10 ton pilot plant, various large-size chemical reaction tubes were prepared as a trial and experimented. The strength of the tubes was satisfactory except for some tubes. The reaction tubes were SiC-CVD treated for cleaning anti-corrosion. Presence of free SiC and C in the CVD film reduces the anti-corrosion and hardness of the film. No troubles were found on adhesion between the film and the base. A large scale CVD unit was manufactured. The trial tubes are under experiment by using a 10 ton pilot plant. The tube had no initial rupture and were durabic to 400 hour operation and cleaning. A large scale reactor was developed, in which the tube structure was modified from the double to the single one. A rough design for a 1000 - 10000 ton / year pilot plant and an automatic control system were developed. The 10 ton / year pilot plant was operated for testing of the reaction tube life time. (3 tabs)

21286 (NEDOJ—8702, pp 26-28) **Low cost silicon purification experiment. Development of chlorosilane hydrogenation process (Investigation of SOG silicon production technique).** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770076/JAW.

In FY 1986 NEDO Annual Report (Part 2).

Production process for solar cell silicon suitable for inexpensive mass-production was examined with evaluation on the practical use of the process. For SOG silicon, 21 processes were examined, from which the 10 processes prospect for future practical use were selected as a standard process for comparison and total evaluation. The evaluation items are processing, starting material, operational condition, consumption energy, silicon qualities, and production cost. The gas purification process, which is preferable from the technical completeness viewpoint has a limitation for low cost purification because of large gas consumption required for gasification. For solid purification, development of impurities-removing technique is urgent. It is suggested that NED direct reduction should be one of the targets for future practical use of solar cells.

21287 (NEDOJ—8702, pp 29-32) **Experiment, construction and demonstration of solar cell panel. Development of techniques for cast substrate production process.** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770076/JAW.

In FY 1986 NEDO Annual Report (Part 2).

The objective of this study is to establish production conditions for cast substrates for high-efficiency solar cells and to develop techniques for improving the properties and productivity of silicon cast ingots and substrates while reducing the required costs. A continuous furnace is improved into a induction-heating type fusion furnace that can produce nine polycrystalline ingots (30 cm square). Another improvement is made to cool the mold bottom more efficiently. Casting conditions are set up based on various test results made with a test continuous casting furnace, permitting the production of ingots at a conversion efficiency of 13.7 percent. Then a conversion efficiency of 13.3 percent is obtained using another cast furnace (No.1 furnace). The incidence of disconnection in multi-wire saws is decreased from 25 percent down to almost 0 percent and the winding time is reduced to about one-third that for conventional instruments. The slicing cost is also decreased by about 30 percent compared to the corresponding figure in 1985. A photoconductivity-attenuation lifetime measuring instrument and simple cell production facilities are installed to improve the ingot evaluation system. (1 fig, 1 photo)

21288 (NEDOJ—8702, pp 33-43) **Experiment, construction and demonstration of solar cell panel. Development of techniques for sheet-type substrate production process.** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770076/JAW.

In FY 1986 NEDO Annual Report (Part 2).

As part of a project for experiment, construction and demonstration of solar cell panels, an effort is made to develop techniques required for producing sheet-type substrates. Various improvements are made in mold modules to increase the productivity. Such improvements include the change in the size of clamp-plate fixing screws and modification in the tapered portion of the upper member of the mold in order to ensure an increased durability; the U-shape hole in the screw portion of the clamp plates; improvement to allow a high-frequency current to flow all over the module; and prevention of improper connection between the inlet and cavity. The improvement made in production processes include the use of a heat insulating box to reduce the heating time; increase in the strength of the high-temperature portions of the mold module driving unit; addition of gas feeding and exhaust systems; and use of a newly developed process for feeding molten silicon continuously at a constant feed rate. It is found that the optimum rotation rate of the mold module is 250-300 rpm and that the time period which can be used for crystal growth is 120 sec or less. It is also revealed that the crystal growth during continuous operation can be controlled by changing the heat capacity of the mold. (9 figs, 3 tabs)

21289 (NEDOJ—8702, pp 44-48) **Research for development of practical high-efficiency crystal solar cell. Development of techniques for producing cells at high efficiency (Development of techniques for high-performance cell structure).** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770076/JAW.

In FY 1986 NEDO Annual Report (Part 2).

The objective of this study is to develop techniques for high-performance cell structures which are required to improve the efficiency of crystal-based solar cells. As the first step of the development of hydrogen bulk passivation techniques, an experiment of bulk passivation by hydrogen ion implantation is started. Evaluation of crystal grain boundaries and intra-grain defects in cast substrates is conducted. Evaluation of surface re-connection rate and lifetime is also carried out. Efforts made for the development of techniques for isohetero junction include the development of a cell characteristics simulator, study on production of low-concentration, low-defect emitters, study on surface treatment, study on polycrystalline Si/single-crystal Si type and crystallite Si type isohetero junction. Work for evaluation of cell production processes includes investigation of the relations of substrate production conditions with cell characteristics, improvement in cell production evaluation processes, and construction and evaluation of small-area cells. A small-area single-crysta cell construction shows a cell efficiency of 20.3 percent, which is among the greatest figures ever achieved in the world. (2 figs, 1 tab)

21290 (NEDOJ—8702, pp 49-53) **Research for development of practical high-efficiency crystal solar cell. Development of techniques for cell production at high efficiency (Development of techniques for producing high-performance cells).** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770076/JAW.

In FY 1986 NEDO Annual Report (Part 2).

The objective of this study is to develop techniques for producing high-performance cells required for high-efficiency crystal solar cells. Investigation of high-temperature oxidation, low-temperature oxidation and thermal oxidation is carried out to provide information required for developing a passivation technique for SOG silicon solar cells. Results indicate that a low-temperature oxidation film has properties that are nearly ideal. A basic study on the designing of metal insulator N/P (MINP) element structures and passivation techniques is conducted, allowing the conversion efficiency of a passivation-type 94 mm x 94 mm cell to reach 14.2 percent. To improve the characteristics of SOG substrates, investigation is made on the effect of anneal gettering and effect of hydrogen passivation performed by the plasma excitation method. In addition, characteristics of SOG substrates are evaluated and another study is carried out to improve the substrate quality by feedback of data to substrate production processes. (4 figs)

21291 (NEDOJ—8702, pp 54-57) **Practical use investigation on high-efficiency crystal solar cell. High-efficiency solar cell production technology.** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770076/JAW.

In FY 1986 NEDO annual report (Part 2).

The investigation aims at establishing an inexpensive production technology for high efficiency polycrystal silicon solar cells, and attaining a conversion ratio above 16% within 1988. In 1986, investigation was made on manufacturing conditions of cast substrates, relationship between the qualities and characteristics of an element, formation of a SiN film by CVD method, and junction-formation. For qualities of th substrate, manufacturing conditions such as removal-position from an ingot lowering speed of the ingot etc., and relationship between the specific resistance of the substrate and characteristics of an element are revealed. The SiN film has a passivation effect and is more useful than an reflection-preventing film. This is suggested to have a certain relation to hydrogen generated in the film-forming. formation of a SiN film on the back side of the substrate is effective. For junction formation, particularly, for an N layer formed by gas diffusion method, influences of removal of the high concentration layer were examined.

21292 (NEDOJ—8702, pp 58-59) **Practical use investigation on high-efficiency crystal solar cell. Examination of high-efficiency techniques.** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770076/JAW.

In FY 1986 NEDO annual report (Part 2).

For enhancing the efficiency of crystalline silicon solar cells, various informations in or outside Japan on evaluation of factors of silicon crystals,and on relationships between the factors and the efficiency of cells were collected, followed by theoretical examination. Particular informations were on point contact cells and evaluation of crystal defects obtained from Japanese and foreign academic circles, symposium, etc. For crystal defects, examination was made on evaluation by Raman scattering, dynamic properties of transition, micro-strain in Ga As crystal, etc.. For high efficiency solar cells, point contact cells, surface passivation techniques, relationship between characteristics of cast substrates and cells, and evaluation of minor carrier were theoretically examined. One-dimensional simulators of solar cells were examined by a computer. An understanding on the evaluation of crystal defects and carrier life was acquired. The relationship between the evaluation and cell characteristics is not apparent.

21293 (NEDOJ—8702, pp 60-63) **Research on practical techniques for producing amorphous solar cell. Research on practical high-quality production techniques (Stainless steel substrate).** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770076/JAW.

In FY 1986 NEDO annual report (Part 2).

The objective of this work is to develop techniques for producing with a high productivity a high-efficiency amorphous solar cell for power generation which is consistent with the spectrum of sunlight. The target performance is an effective efficiency of above 10 percent for a cell of 10 cm x 10 cm and an initial deterioration rate of below 10%/year. This research was started in 1980 and accessfully developed at 10 cm square three-layer type solar cell of a conversion efficiency of 9.6 percent (effective efficiency of 8.25 percent) in 1985. The 1986 study deals with production conditions for a-SiGe (narrow gap material). The study has revealed that a high-quality a-SiGe film can be produced by the helium dilution P-CVD (chemical vapor deposition) method using a feed gas composed mainly of fluorine. In pursuit of techniques for designing and producing tandem-type cells, an effort is made to develop a production process based on results of computerized simulation. Thus an increased Voc is achieved, resulting in a three-layer type solar cell with an effective efficiency of 9.2 percent. It is shown that both the residual stress and the number of Si-H_2 bonds should be reduced to decrease the deterioration rate while keeping a high efficiency. (2 figs)

21294 (NEDOJ—8702, pp 64-67) **Research for development of practical amorphous solar cell. Research on practical techniques for producing amorphous solar cell (Research on practical high-performance production techniques and new film formation method).** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770076/JAW.

In FY 1986 NEDO annual report (Part 2).

The objective of this study is to develop new film formation methods, interface control techniques and cell production techniques in order to provide high-quality amorphous films for solar cells and to improve cell production processes. As a new film formation technique, the microwave plasma CVD method is examined, and an a-Si:H film and a-SiGe:H film with good properties are produced. Then the bias control plasma CVD method is employed to successfully produce a high-quality a-Si:H film from monosilane at a high rate of 30A/S. A computer-aided CVD method is developed to control the monoatomic-level layer thickness, resulting in an untra-thin multilayer film. A solar cell is constructed by these techniques and using a parallel-plate type plasma CVD apparatus equipped with an interface control device. The solar cell achieves a photoelectric conversion rate of 11.1 percent. Other solar cells produced by the bias control plasma CVD method at a film formation rate of 4A/S and 15A/S, are found to have photoelectric conversion rates of 11.2 and 10.3 percent, respectively.(7 figs)

21295 (NEDOJ—8702, pp 68-72) **Research for development of practical amorphous solar cell. Research for development of practical high-performance production techniques (Glass substrate).** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770076/JAW.

In FY 1986 NEDO annual report (Part 2).

The objective of this study is to improve the quality of materials required for amorphous solar cells, particularly for tandem cells, and to apply them to the production of a high-performance single-layer cell. In addition, the resultant cell is applied to a tandem cell to provide a high-efficiency cell made up of a glass substrate. A radicals control technique is developed to produce

high-quality narrow gap material. Characteristics of the bond interface in a narrow gap cell are improved, and an investigation is made to enhance the performance of an a-SiGe single-layer cell. The structure and bond interface of the tandem cell are examined and an optimum structure is identified to increase the efficiency of the tandem cell. For mercury sensitization CVD, the pressure used during film formation is decreased to allow radicals to be used selectively, permitting the prevention of secondary reactions. the adoption of a high-quality film and improvement in the cell's p/i interface result in high-efficiency 2-layer and 3-layer tandem cells. (5 figs)

21296 (NEDOJ—8702, pp 73-77) **Research for development of practical amorphous solar cell. Research on practical techniques for producing amorphous solar cell (Research on techniques for producing large-area cell).** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770076/JAW.

In FY 1986 NEDO annual report (Part 2).

The objective of this study is to develop techniques for producing high-efficiency large-area cells required for establishing practical techniques for providing amorphous solar cells for power generation. Efforts made in 1986 include further investigations on large-area solar cell process techniques as well as improvement in properties of the film used as buffer layer at the p/i interface and in the surface shape of the transparent conductive film. These efforts to enhance the efficiency permit the construction of a sub-module that has an area of 1,200 cm^2 and effective efficiency of 8.1 percent. A study on large-area a-Si film formation techniques results in a new IVE-type apparatus that can produce a film over a substrate of an area of 4,800 cm^2. In pursuit of techniques for producing high-efficiency large-area cells, other efforts are made to improve the quality of the a-Si:H film used as buffer layer at the p/i interface and to identify the optimum surface shape and thickness of the transparent conductive SnO_2 film, in order to further improve the efficiency of the a-Si solar cell of 1,200 cm^2. (4 figs)

21297 (NEDOJ—8702, pp 78-82) **Research for development of practical amorphous solar cell. Research on practical techniques for producing amorphous solar cell (Research on practical high-efficiency production techniques).** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770076/JAW.

In FY 1986 NEDO annual report (Part 2).

As part of a research seeking to provide practical techniques for amorphous solar cells for power generation, an attempt is made to develop some techniques for producing high-efficiency amorphous solar cells. The techniques covered include those for rapid production of high-quality amorphous films, designing of high-efficiency solar cell structures, and laser patterning for producing accumulation-type solar cells. Investigation is made to determine whether good features of the plasma separation triode method can be applied to the development of a controlled plasma magnetron discharge method that can produce films more rapidly. An effort is made to develop a method to produce a-Si films with improved properties by using a super-chamber. Other efforts include the production of high-quality films by the photo-CVD method and the development of an a-Si solar cell with a power of 836 mW by using the YAG laser patterning method. A study on the prevention of light deterioration reveals that a reduced density of Si-H_2 bonds in the i layer, coupled with a reduced concentration of impurities in the film, leads to a decrease in light deterioration. (7 figs)

21298 (NEDOJ—8702, pp 83-86) **Research for development of practical techniques for producing amorphous solar cell. Research on practical high-efficiency production techniques (Rapid film formation techniques).** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770076/JAW.

In FY 1986 NEDO annual report (Part 2).

The objective of this study is to develop a new film formation technique based on mechanisms of rapid formation of high-quality amorphous films and to carry out rapid production of high-performance amorphous solar cells from new materials such as disilane. Improved methods for producing a p layer and p-i interface are developed while an i layer is formed using a high-vacuum film formation method. As a result, a film formation rate of 3A/S is achieved and a solr cell with a photoelectric conversion rate of greater than 10 percent is constructed. For the production of a-si films from disilane, the dependence of film formation rate on supplied energy is investigated to determine the effect of the concentration of remaining disilane on the film formation rate and film quality. It is revealed that the use of film formation rate control and plasma control works effectively for rapid production of solar cells. It is also found that the control of film formation from disilane can be performed effectively by monitoring the intra-plasma parameters. Another effort is made to determine whether the initial discharge can be eliminated from the rapid film formation processes. (4 figs)

21299 (NEDOJ—8702, pp 87-91) **Research for development of practical amorphous solar cell. Research on practical high-efficiency production techniques (Flexible substrate).** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770076/JAW.

In FY 1986 NEDO annual report (Part 2).

The objective of this study is to analyze each process for the production of rolled film to be used for solar cells made up of a polymer film substrate, and to develop a high-efficiency process for providing accumulation-type modules by the rolled film production method. When a roll-to-roll film production apparatus composed of three separate chambers is to be used for continuously depositing p, i, n and a-Si film onto a traveling PET/Al/SS substrate, the substrate film should be allowed to move through a stable plasma atmosphere to provide a uniform layer at the bond interface. An attempt is made to control the distribution of the reaction gas in the i reaction chamber. The use of a third electrode (mesh electrode) in the i reaction chamber is examined. For substrate production, a study is being conducted on continuous roll-to-roll production to provide most appropriate rough-surface Al films that can efficiently confine light. In connection with the production of modules by the roll-to-roll method, investigation is made on the effect of a laser beam applied to the cell from behind. (3 figs)

21300 (NEDOJ—8702, pp 92-95) **Research for development of practical amorphous solar cell. Research on practical high-reliability production techniques (Element interface formation techniques).** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770076/JAW.

In FY 1986 NEDO annual report (Part 2).

In pursuit of practical amorphous solar cells for power generation, a study is made to clarify the process and cause of deterioration in the performance of solar cells and to develop high-reliability solar cells. An a-SiC:H film with a decreased content of defects is produced by controlling the electric discharge voltage depending on the decomposition energy of SiH_4 and CH_4 during the a-SiC:H film production process. An analysis of surface reactions during an intermittent film production process shows that the reaction of fluorine elimination by hydrogen occurs very rapidly. An attempt is made to produce an a-Si:H:F film from a monofluorosilane (SiH_3F). At a substrate temperature of 200-250°C, this film has a photoconductivity of 4×10^{4} Scm^{-1} and light/dark electric conductivity of about several hundred thousands. it is revealed that the decrease in photoconductivity of the a-Si film depends greatly on the number of defects resulting from re-combination of free carriers. (2 figs)

21301 (NEDOJ—8702, pp 96-100) **Research for development of practical amorphous solar cell. Research on practical high-reliability production techniques (Clarification of element deterioration mechanism).** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770076/JAW.

In FY 1986 NEDO annual report (Part 2).

The objective of this study is to clarify the mechanism of light deterioration in amorphous solar cells and to develop high-reliability elements. Films containing several impurities such as boron and phosphorus are examined. Impurities have no effects on the number of defects in the impurities content range investigated. The spin density is found to change due to the shift of the Fermi level. A solar cell made up of a film containing both boron and phosphorus is irradiated with light for four hours. While an impurities-free element with an initial conversion efficiency of 10.2 percent suffers from 45 percent deterioration after irradiation in an exposed state,

the above impurities-containing element, with an initial conversion efficiency of 8.2 percent, undergoes 36 percent deterioration in the same state, indicating that light deterioration is controlled. In an element containing impurities in a specific distribution, changes in characteristics can be controlled if defects are produced by light irradiation. It is also revealed that irradiation of a solar cell with near infrared rays under a negative bias condition can improve the characteristics of the element. (6 figs)

21302 (NEDOJ—8702, pp 101-104) **Research for development of practical amorphous solar cell. Research on practical high-reliability production techniques (Research on practical techniques for producing transparent electric conductive film at low cost).** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770076/JAW.

In FY 1986 NEDO annual report (Part 2).

The objective of this study is to establish CVD conditions for producing a film with a sheet resistivity of 5 omega and transmittance of 85%, to improve apparatus to produce large-area (40 cm x 120 cm) films and to develop plasma-resistant materials. The investigations of film production processes cover techniques to increase the transmittance, effect of methanol addition on the CVD reaction, and changes in conductive films caused by re-heating. Optimum lamination conditions are identified and a film with a sheet resistivity of 5 omega and transmittance of 85% is produced. The weather resistance of the conductive film is 5,000 hours and 400 days in a whetherometer and in natural environment, respectively. A belt-conveyer type CVD apparatus with a width of 40 cm is constructed. A 40 cm x 30 cm substrate produced has a film thickness fluctuation of +-12 - 15% in the width direction and its transmittance is found to be about 81% at a sheet resistivity of 5 omega. The puttering technique is used to produce a titanium carbide layer on a conductive film and its resistance to plasma is determined. (3 figs)

21303 (NEDOJ—8702, pp 105-107) **Research for development of practical amorphous solar cell. Review of analysis of practical techniques.** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770076/JAW.

In FY 1986 NEDO annual report (Part 2).

The objective of this work is to make a close examination of up-to-date technical information on amorphous solar cells collected in Japan and from all over the world and to support the project for research and development of amorphous solar cell for power generation by allowing the information to be reflected effectively in the project. The work, conducted in 1986, is focused on the review of basic techniques for amorphous solar cells to determine the limits of them. The items covered by the review include the progress in film production techniques and process techniques; new information on properties of amorphous silicon materials; improvement in properties of amorphous silicon alloy films; enhancement of quality of transparent conductive films; new techniques for increasing the efficiency; 2- and 4- terminal stacked cells; key techniques for long-term stable operation; light deterioration in amorphous silicon solar cells; and techniques for its control. It is stressed that future research and development work should include a study on light deterioration to ensure high stability and development of techniques for producing elements to be incorporated in devices required for high-efficiency tandem solar cells.

21304 (NEDOJ—8702, pp 108-111) **Research and development of solar cell evaluation system.** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770076/JAW.

In FY 1986 NEDO annual report (Part 2).

The objective of this work is to develop techniques for performance testing and weather resistance testing to evaluate the performance of solar cells accurately and impartially. Work for performance evaluation includes the development of a long pulse light type large solar simulator that can serve for increase the accuracy of evaluation of amorphous solar cell modules. A test is made to determine the performance of an automatic solar spectrum measuring apparatus. To dermine the reliability of an amorphous solar cell module, an outdoor exposure test, weatherometer test and heat-moisture cycle test are carried out. The outdoor exposure test shows that deterioration tends to occur rapidly in winter rather than in summer. The weatherometer test is continued for 4,260 hours under the conditions of continuous irradiation and periodic rain. The deterioration, Pmax, is found to be 5 to -15 percent. The module undergoes 8 to -23 percent changes when subjected to about 200 cycles in the heat-moisture cycle test. (1 fig)

21305 (NEDOJ—8702, pp 112-116) **Research and development of solar cell evaluation system. Research on power supply system in remote area.** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770076/JAW.

In FY 1986 NEDO annual report (Part 2).

The objective of this research is to develop a reproductive energy system structure that is suitable for power supply in remote areas in Australia, carry out conceptual designing and estimation of the construction costs, and evaluate the technical and economic feasibility. The equipment is to consists of a photovoltaic unit (PV), diesel engine (DEG) and battery. The load capacity is 6 kW for residential houses, 25 kW for public buildings and 80 kW for small communities. A computer program is developed to simulate the operation of the constitutent units of the equipment. Preliminary simulation is performed using one month data in Balladonia. An investigation on the relations of the PV capacity with the amount of DEG fuel saved indicates that up to a PV capacity of about 150 kWp, the DEG fuel is saved proportionally to the PV capacity. A study is carried out to solve technical problems such as the management of the batteries at the site and the operation of a DEG and an inverter connected in series. A Japan-Australia joint meeting is held to make an interim examination. (2 figs)

21306 (NEDOJ—8702, pp 117-121) **Development of photovoltaic power generation system. Research and development of peripheral techniques (Basic study on power generation rate).** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770076/JAW.

In FY 1986 NEDO annual report (Part 2).

In this work, the solar radiation quantity required for location planning and designing of a photovoltaic power plant is surveyed and analyzed from a practical point of view, and basic related data are collected and improved. A model developed in the 1984 and 1985 studies for estimating the solar radiation quantity on a slanting plane is used to calculate the solar radiation quantity on a slanting plane at 225 places over the country. Based on these calculations, the following characteristics are examined: optimum slanting angle, dependence of the slanting plane solar radiation quantity on the azimuth and slanting angle, ratio of each solar radiation component to the total solar radiation on a slanting plane, and effect of the azimuth on the daily changes in solar radiation on a slanting plane. The error in the estimation of the slanting plane solar radiation quantity in the nation's 225 points covered by this study is about 5 percent. Helpful data are selected out of the results of meteolorogical studies performed under the Sunshine project, and compiled with attached notes necessary for their utilization. These data cover the solar radiation time, global solar radiation time, sky solar radiation quantity and atmospheric transmittance at various places over the country.

21307 (NEDOJ—8702, pp 122-126) **Research and development of frame for solar cell. Research on solar cell array combined with building material for private-house.** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770076/JAW.

In FY 1986 NEDO annual report (Part 2).

The objective of this work is to develop a low-cost solar cell array combined with building material which can make the best use of a solar cell to be used in private houses. To establish basic techniques for constructing a solar cell array combined with building material, hybrid modules are produced by combining roofing materials with solar cells and investigation is made to determine the optimum structure. A solar cell made of amorphous Si, single crystal Si or polycrystalline Si is combined with a building material such as glass slate roof tile or asbestos slate roof tile to construct building material - solar cell hybrid modules. Investigation is made on the connection and installation of hybrid modules taking into account actual installation conditions. Various modules constructed are subjected to outdoor exposure testing. Results show that a three-month exposure has no adverse effect on their performance and that no

abnormalities including separation and discoloration occur in the laminated portions. Various accelerated tests to determine the reliability in a short period of time are carried out with good results. (7 figs)

21308 (NEDOJ—8702, pp 127-131) **Research and development of frame for solar cell. Research on solar cell combined with building material for office buildings .** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770076/JAW.

In FY 1986 NEDO annual report (Part 2).

The objective of this work is to develop a low-cost solar cell array combined with building material which can make the best use of a solar cell to be used in office buildings. To carry out first-phase trial construction and designing, a model building is assumed and some natural factors (including wind, earthquake, rain and heat), laws concerned and conditions for construction and maintenance are selected to be examined in the study. A temporary building is designed to be used for confirmative tests of building work, etc. The model building is assumed to be located in Tokyo and have four stories. Its roof is assumed to be of solar cell module combined with roofing material. A panel is constructed using a polycrystalline silicon solar cell module, aluminum frame and fiberglass reinforced concrete. The panel constructed is subjected to performance testing. Results show that it should be improved with respect to shear deformation and water tightness. A workability test is also carried out with satisfactory results. (3 figs)

21309 (NEDOJ—8702, pp 132-136) **Research and development of electric transformer for photovoltaic power plant. For independent power source.** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770076/JAW.

In FY 1986 NEDO annual report (Part 2).

The objective of this work is to develop a high-efficiency, high-reliability, low-cost, small-sized orthogonal transformer to be used in a 10 KW-class independent power source. A No.1 inverter, of a BIMOS-transister type, is constructed on an experimental basis to be used for performance testing. Electrical performance with respect to distortion factor and loss is evaluated in relation to various control methods and control circuit constants. It is found that pulse width modulation (PWM) can be performed more efficiently by the conventional sine wave -chopping wave comparison procedure than by the proposed improved procedure. The maximum efficiency is estimated at 95 percent from loss characteristics. A No.2 trial inverter is constructed based on results of evaluation tests of the No.1 trial inverter and examination of the structure of its cooling device. The main circuit of the inverter is of the PWM type and the sine wave -chopping wave comparison procedure is adopted. A modulation frequency of 10 KHz is used. A BIMOS transister is employed as semiconductor diode while a 16-bit microcomputer is used to perform the control and protection operation in order to provide a compact system. (5 figs, 1 tab)

21310 (NEDOJ—8702, pp 137-141) **Research and development of electric transformer for photovoltaic plant. For system connection.** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770076/JAW.

In FY 1986 NEDO annual report (Part 2).

The objective of this work is to develop a high-reliability, high-efficiency, low-cost, maintenance-free, 3 KW-class electric transformer to be used for system connection. A No.1 trial transformer is constructed and used in demonstration tests for the switching frequency characteristics of three types of switching devices (MOS TOP, MOS FET, and IGBT) and various PWM-controlled main circuits. Results show that the power factor is 1, with the distortion factor of the high-frequency voltage wave profile being smaller than about -40 dB as compared to the fundamental wave and the transformation efficiency being about 90 percent. A No.2 trial transformer is developed, in which the control and protection circuits are composed of custom LSI's. Reduced-size circuit members are developed leading to a decrease in volume by 30 percent compared to the No.1 trial transformer. IGBT is employed as the main circuit device to reduce the cost and size. Evaluation is made based on simulation studies. Results show that the characteristics of the d.c. side portion of the electric transformer is greatly dependent on the loading conditions. (2 figs, 1 tab, 1 photo)

21311 (NEDOJ—8702, pp 142-145) **Research and development of electricity storage system for photovoltaic power plant (enclosed type).** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770076/JAW.

In FY 1986 NEDO annual report (Part 2).

The objective of this work is to develop a long-life, maintenance-free, low-cost, cathode-absorption type enclosed lead battery to provide an electricity storage system that is suitable for use in combination with solar cells in photovoltaic power plants. In the 1986 study, detailed investigations are made, based on results of the basic study in 1985, to determine effective electrode structures and plate arrangement that can improve the positive and negative plate performance. A study on battery structure covers requirements for maintenance-free operation, integrated battery structure and large-scale batteries. Batteries are constructed on an experimental basis and subjected to tests and evaluation. Methods for testing electricity storage systems are also examined. A study on electrode structure shows that clad-type plates with a large tube diameter seem to be promising. It is also revealed that a plate arrangement using retainer-type paste is superior with respect to discharge capacity. For maintenance-free operation, four packing materials for electrode pole sealing are tested with good results. (12 figs)

21312 (NEDOJ—8702, pp 146-149) **Research and development of electricity storage system for photovoltaic power plant (open type).** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770076/JAW.

In FY 1986 NEDO annual report (Part 2).

The objective of this work is to develop a long-life, large-capacity, maintenance-free, low-cost, vent-type lead battery to provide an electricity storage system that is suitable for use in combination with solar cells in photovoltaic power plants. To provide a high-performance plate assembly, investigations are made on the structure of the separator, alloy materials for the grating and its shape. A test of small cells (150Ah class) is performed. To develope an integrated system, a study is made to determine the optimum shape, structure and integration method for a plate assembly, optimum shape of an electrolytic bath and its lid, and unit cell connection methods required. A 600 Ah cell is constructed and tested. A sunlight simulation pattern test is constructed and tested. A sunlight simulation pattern test is performed for cells with an embossed separater or a rib-type separator. Good results are obtained with respect to changes in capacity. A band pressurization process is selected to reduce the production cost for these units. These investigations make it possible to produce a small-depth, long-life electrolyte bath. (3 figs)

21313 (NEDOJ—8702, pp 150-153) **Research and development of photovoltaic power generation system. Survey of methods for test and evaluation of peripheral instruments.** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770076/JAW.

In FY 1986 NEDO annual report (Part 2).

The objective of this work is to determine required performance of peripheral instruments, such as solar cell frame, electric transformer and storage battery, that rate necessary for constructing a photovoltaic power generation system to be used as an independent electric source or for system connection. An effort is also made to establish unified methods for test and evaluation of them. To investigate the requirements for the performance of peripheral instruments, a survey is made of domestic and overseas efforts to develop solar cell frames, inverters or batteries. Detailed required performance and performance items are examined for each instrument. For the batteries currently under research and development by the New Energy Development Organization, it has been found that tests and evaluation should be performed at the trial cell construction stage. Thus the study on peripheral instrument test and evaluation methods is focused on developing tentative battery test and evaluation methods to be used for the time being. In pursuit of techniques for evaluating the performance and costs for peripheral instruments, a survey is made of the progress of research and development of the peripheral instruments, and an analysis is carried out to determine the costs required at the current technical level and to predict future developments. (3 figs)

21314 (NEDOJ—8702, pp 214-219) **Centralized type photovoltaic power generation system. Dispersed array type photovoltaic power generation systems.** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770076/JAW.

In FY 1986 NEDO annual report (Part 2).

Wider utilization of solar cells requires establishment of a centralized type photovoltaic power generation system (dispersed array type). Successively from 1985 fiscal year, in 1986, the 200 kW system was continuously operated with the simulated distribution lines loaded in a practical distribution pattern. Measurement and evaluation were made on influences of the dispersed array type system on qualities of the power distributed through practical distribution lines, revealing no problems on the practical-use. Standardization of detection condition of abnormalities in in-unit distribution lines, and an abnormality detection system of distribution lines by an inter-unit multi-point evaluation were proposed, and the effectiveness was demonstrated. For storage equipment, a tide-stabilized operation system utilizing the units, and a stabilized power operation system were proposed. The effectiveness of these system as an electric utility system is revealed from the voltage stabilization of distribution lines. (2 figs, 2 tabs)

21315 (NEDOJ—8702, pp 220-224) **Centralized type photovoltaic power generation system. Dispersed array type photovoltaic power generation systems for remoto islands.** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770076/JAW.

In FY 1986 NEDO annual report (Part 2).

This study deals with practical application of a photovoltaic system in the remote island area by examining the system from the technical and economical viewpoints, based on the feasibilities of the system in the remote island area. The analysis of the load pattern in the area has revealed that introduction of the PV system into the area is suitable or not, depending on the industries in the remote islands. For feasibility study on the on-ground installed PV system, the outline design of a PV system in Keirama Islands, Okinawa Prefecture, was made, in which the existing 50 kW PV system is to be worked in cooperation with a diesel generation system. According to the system, the photovoltaic power units are installed on the roofs of the buildings in a resort to be developed. Targets for examination on the PV system from the economical viewpoints were defined.

21316 (NEDOJ—8702, pp 225-230) **Centralized array type photovoltaic power generation systems.** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770076/JAW.

In FY 1986 NEDO annual report (Part 2).

This report describes the results of investigation in FY 1985 for establishing a concentrated photovoltaic power system which serves for wider application of solar cells. Demonstration test of the 1000 kW system, developed in FY 1985, was made as to efficient operation, output stabilization, combination technique with other systems, and independent operation, giving the operation control data for improving and evaluating the concentrated-arrangement system. For the practical electric generation in FY 1986, the inclination solar flux was 3.78 kWh/m day, and the generated electric energy was 4234 kWh/day. No changes in the output of the crystal solar cells were found, while the amorphous solar cells had about 20% reduction in the output for February to March, based on the output for July to August. As to the charge and discharge characteristics of the electric batteries, the longer use time reduced an unbalance between the charge and the discharge of the battery. For the operation characteristics of the concentrated system, a significant change in the output was found. (4 figs, 3 tabs)

21317 (NEDOJ—8702, pp 231-235) **Study on Solar-thermal hybrid type photovoltaic power generation system.** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770076/JAW.

In FY 1986 NEDO annual report (Part 2).

This study aims at developing a flat solar-thermal hybrid system (roof-mounted type), by which solar energy is caused to supply a demand of electric and thermal energy for houses. The solar cells of the hybrid panel which was produced as a trial in FY 1985, were partially improved, and tested. The total efficiency was above 60% at the atomospheric temperature of 28°C, the solar flux of 1 kW/m², and the solar collection temperature below 45°C. The analysis on the system performance by computerized hybrid simulation has revealed that, in case of such a high solar collection as in the test of this hybrid system, simplification of the thermal energy system leads to relatively significant improvement in the hybrid system performance. A demonstration hybrid system was designed and produced. The hybrid panel has the electric output of 3.2 kW and the thermic output of 24 kW. This demonstration hybrid system is equipped with home electric appliances, air-conditioners, hot-water supplying apparatus, etc. for demonstration test. (1 fig)

21318 **(NEDOJ—8702) FY 1986 NEDO Annual Report (Part 2).** (New Energy Development Organization, Tokyo (Japan)). Sep 1987. 453p. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770076/JAW.

This second part of the FY 1986 report pertains to research on solar cells. Each paper has been indexed for inclusion in the Energy Data Base.

21319 **(NMRDI—2-72-4213) Technical and economical feasibility of buffalo gourd as a novel energy crop: Final report.** Goldstein, B. (New Mexico Solar Energy Inst., Las Cruces (USA)). Feb 1988. 241p. NTIS, PC A11/MF A01 - NMRDI, 457 Washington S.E., Albuquerque, NM 87108. Order Number DE88900458/JAW.

The New Mexico Solar Energy Institute at NMSU has conducted a two-year investigation into the technical and economic feasibility of using the buffalo gourd plant as an energy feedstock in eastern New Mexico. The New Mexico buffalo gourd project conducted field planting trials to determine optimum planting density, fertilizer levels, and irrigation regime. Starchy roots produced by the field plantings were evaluated as an ethanol feedstock at both laboratory and pilot scale. These studies indicate that buffalo gourd is well suited for root production in eastern New Mexico. Current cultivars of buffalo gourd can be most efficiently produced under dry land farming conditions with little, if any, supplemental fertilizer. Traditional plant breeding techniques can be profitably employed on the buffalo gourd to breed a size and shape of root more easily harvested by existing farm machinery. Because of its sensitivity to root rot, buffalo gourd must be grown in well drained soils. Finally, buffalo gourd has been shown to be an excellent feedstock for ethanol production provided necessary pre-fermentation processing (chopping of roots) is performed correctly. A model was created to determine the economic feasibility of growing buffalo gourd in eastern New Mexico. It was determined that the net return to a farmer in eastern New Mexico can be higher planting buffalo gourd than many traditionally grown crops because of buffalo gourd's low water and fertilizer requirements. The model further indicates that net return is heavily influenced by root yield. Continued research is needed to optimize buffalo gourd root yield, as well as root size and shape, disease resistance, etc. A clearly defined R & D agenda and commercialization strategy is presented and discussed. Buffalo gourd has been demonstrated to have high potential as an alternative feedstock for ethanol production in eastern New Mexico. 128 refs., 9 figs., 28 tabs.

21320 **(PB—88-135827/XAB) Aboveground tree biomass on productive forest land in Alaska. Forest Service research paper.** Yarie, J.; Mead, D.R. (Forest Service, Portland, OR (USA). Pacific Northwest Research Station). Aug 1982. 22p. (FSRP-PNW—298). NTIS, PC A03/MF A01.

Total aboveground woody biomass of trees on forest land that can produce 1.4 cubic meters per hectare per year of industrial wood in Alaska is 1.33 billion metric tons green weight. The estimated energy value of the standing woody biomass is 11.9 x 10 Btu's. Statewide tables of biomass and energy values for softwoods, hardwoods, and species group are presented.

21321 **Investigation of short circuit current sublinearities in high resistivity base silicon solar cells.** Banghart, E.K.; Gray, J.L.; Schwartz, R.J. (School of Electrical Engineering, Purdue Univ., West Lafayette, IN 47907). pp 1396-1401 of Nineteenth IEEE photovoltaic specialists conference, 1987. (Conference Record). Piscataway, NJ; IEEE Service Center (1987). (CONF-870528—).

From 19. IEEE photovoltaic specialists conference; New Orleans, LA, USA (4 May 1987).

Mechanisms which lead to a sublinearity of the short circuit current as a function of illumination intensity in conventional geometry, high resistivity base silicon solar cells are examined. A computer simulation code, SCAP1D, is used for the study. It is shown that the sublinearity of the short circuit current is due to the loss of base conductivity modulation coupled with a source of high recombination in the cell. It is also shown that a modification of the superposition principle can be used to model the intensity dependence of the sublinearity. Excellent agreement with experimentally observed sublinearities is demonstrated by the code for a 500 ohm-cm cell designed by Varian.

21322 **A fast-transient technique for separating base and emitter recombination components in planar silicon solar cells.** Basore, P.A. (Sandia National Labs., Albuquerque, NM 87185-5800). pp 1162-1167 of Nineteenth IEEE photovoltaic specialists conference, 1987. (Conference Record). Piscataway, NJ; IEEE Service Center (1987). (CONF-870528—).

From 19. IEEE photovoltaic specialists conference; New Orleans, LA, USA (4 May 1987).

A new fast-transient technique is presented which directly determines the base component of a solar cell's dark current using data from a single short-circuit current decay measurement. The technique is based on fitting the measured cell current to the form expected for the diffusion of minority carriers into a semi-infinite slab. The approach is limited to small-area cells that operate in low-level injection. The validity of the fast-transient technique is established by performing detailed numerical simulations of the transient experiment for worst-case and typical cell configurations. Experimental results are given for five low-resistivity cells that are expected to have similar base characteristics, confirming that consistent results can be obtained by this method.

21323 **Theoretical comparison of conventional and unconventional GaAs cell design.** DeMoulin, P.D.; Lundstrom, M.S. (School of Electrical Engineering, Purdue Univ., West Lafayette, IN 47907). pp 925-930 of Nineteenth IEEE photovoltaic specialists conference, 1987. (Conference Record). Piscataway, NJ; IEEE Service Center (1987). (CONF-870528—).

From 19. IEEE photovoltaic specialists conference; New Orleans, LA, USA (4 May 1987).

A theoretical comparison of conventional and unconventional GaAs cells was performed to assess the potential of back-contrast cells. Using the same set of assumptions (lifetimes near the radiative limit and the best reported surface-recombination velocities), numerical simulation results demonstrate that the conventional p/n heteroface cell and a dot-geometry back-contact cell have upper-limit conversion efficiencies of —34% at 500 suns AM1 when contact-grid shadowing and reflections are neglected. However, a back-contact cell degrades severely under concentration as the cell thickness increases. Although the internal performance of the point-contact cell is not expected to be better that that of the conventional heteroface cell, the elimination of contact-grid shadowing is a definite advantage.

21324 **Encapsulant free-surfaces and interfaces: Critical parameters in controlling cell corrosion.** Mon, G.R.; Wen, L.; Ross, R.G. Jr. (Jet Propulsion Lab., California Institute of Technology, Pasadena, CA). pp 1215-1221 of Nineteenth IEEE photovoltaic specialists conference, 1987. (Conference Record). Piscataway, NJ; IEEE Service Center (1987). (CONF-870528—).

From 19. IEEE photovoltaic specialists conference; New Orleans, LA, USA (4 May 1987).

The authors present some results of studying the interaction of moisture with photovoltaic (PV) modules and custom-built test coupons in both laboratory and outdoor ambient environments. They measured module cell-to-frame leakage currents, encapsulant bulk and surface currents, glass surface currents, and encapsulant/glass interface currents as functions of temperature and humidity. Using a computer model of inter-electrode conduction, the authors delineate preferential conduction paths in PVB- and EVA-encapsulated modules. In comparing the results of field and laboratory test environments on identical samples, they note and comment upon the greater severity of the outdoor environment. The authors conclude with a discussion of several aspects of water-module interaction, including design strategies and continuing research aims.

21325 **Ink jet assisted metallization for low cost flat plate solar cells.** Teng, K.F.; Vest, R.W. (School of Electrical Engineering, Purdue Univ.). pp 1430-1434 of Nineteenth IEEE photovoltaic specialists conference, 1987. (Conference Record). Piscataway, NJ; IEEE Service Center (1987). (CONF-870528—).

From 19. IEEE photovoltaic specialists conference; New Orleans, LA, USA (4 May 1987).

Computer controlled ink jet assisted metallization of front surface of solar cells with metallo-organic silver inks offers a maskless alternative method to conventional photolithography and screen printing. This method can provide low cost, fine resolution, reduction in process complexity by direct ink jet print patterning, avoidance of degradation of the p-n junction by firing at lower temperature and uniform line film on rough surface of solar cells. The metallization process involves ink jet printed metallo-organic inks, belt furnace firing, and thermal spiking. With multilayer ink jet printing and firing, about 5-6% efficiency solar cells without AR coating can be produced. With a titanium thin film underlayer as an adhesion promoter and multilayer ink jet printing, solar cells of average efficiency 8.08% without AR coating can be obtained. This efficiency value is approximately equal to that of thin film solar cells of the same lot. The problems of lower inorganic content of MOD inks and contact resistance are noticed.

21326 **Promising thin film solar cells: An overview.** Stone, J.L. (Solar Electric Conversion Research Div., Solar Energy Research Institute, 1617 Cole Boulevard, Golden, CO 80401). pp 2-4 of Photovoltaics for solar energy applications II. Adler, D. Bellingham, WA; Society of Photo-Optical Instrumentation Engineers (1983). (CONF-830420—). Contract AC02-77CH00178.

From Society of Photo-Optical Instrumentation Engineers conference; Arlington, VA, USA (4 Apr 1983).

Several thin film solar cell materials have demonstrated greater than 10% conversion efficiency, including amorphous silicon, polycrystalline silicon, cadmium sulfide/copper sulfide, cadmium sulfide/copper indium diselenide, gallium arsenide (CLEFT), cadmium sulfide/cadmium telluride, and gallium arsenide/silicon. The generic category of thin film solar cells is examined to determine prerequisites for use of these materials for large quantities of competitive electrical energy production. The future extrapolated performance, low cost potential, and areas for further research are discussed.

21327 **Progress in copper indium diselenide thin-film photovoltaic device research.** Hermann, A.; Zweibel, K. (Solar Electric Conversion Research Div., Solar Energy Research Institute, 1617 Cole Boulevard, Golden, CO 80401). pp 96-106 of Photovoltaics for solar energy applications II. Adler, D. Bellingham, WA; Society of Photo-Optical Instrumentation Engineers (1983). (CONF-830420—). Contract AC02-77CH00178.

From Society of Photo-Optical Instrumentation Engineers conference; Arlington, VA, USA (4 Apr 1983).

Recent results on CuInSe/sub 2/ from the United States Department of Energy (DOE) Polycrystalline Thin-Film Device Program are presented. The program, managed by the Solar Energy Research Institute (SERI), encompasses materials and device research in a variety of highly absorbing compound semiconductors with emphasis on CuInSe/sub 2/, for which thin-film device efficiencies of 11% (AM1) have been reported. This paper describes film deposition techniques including coevaporation from the elements, reactive sputtering, and spray pyrolysis. Electrical and opti-

cal characterization of the films is discussed, and experiments on control of carrier type and concentration are outlined. Differences from corresponding results on single-crystal CuInSe/sub 2/ are discussed in terms of defect-chemistry models. Experiments on heterojunction formation of CuInSe/sub 2/ with CdS or (Cd,Zn)S are presented, and recent results in device characterization and modeling are discussed. Central problems in the achievement of higher efficiency devices are described. Low open-circuit voltages and the role of oxygen in post-deposition anneal are discussed. Scalability of techniques for the deposition of device-quality CuInSe/sub 2/ is also discussed in light of the recent announcement of plans for commercialization of thin-film CdS/CuInSe/sub 2/ devices.

1406 Photovoltaic Power Systems

REFER ALSO TO CITATION(S) 21305, 21306, 21307, 21308, 21309, 21310, 21311, 21312, 21313, 21314, 21315, 21316

21328 (NEDOJ—8401, pp 291-298) **Research and development of peripheral technology related to photovoltaic power generation.** Aug 1984. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770050/JAW.

In FY 1983 NEDO Annual Report.

Research and development activities were performed for peripheral technology needed to incorporate solar cells in the power system and accomplish actual power generation. These activities focused on investigation for optimal system configuration and for clarifying problems concerning linkage between the solar and power systems. By 1982, investigation for optimization of photovoltaic power generation systems was conducted using 3 KW separately excited and 3 KW self-excited photovoltaic power generation experiment systems. This investigation was performed through efforts for clarifying the power generation and running characteristics of the system and local differences in power generation characteristics, conducting simulation of various practical-scale systems for their power generation and running characteristics, and designing smaller and simpler system components. Also, mutual interference of multiple photovoltaic power generation systems and their protection in the event of abnormalities were studied through experiments in which the solar system linked to a simulated power system was actually run. The solar cell array used was amorphous type in the 2 KW system and single crystal type in the 3 KW system. In either system, the orthogonal converter was self-excited type without a transformer. (4 figs)

21329 (NEDOJ—8401, pp 299-306) **Photovoltaic power system for single family houses.** Aug 1984. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770050/JAW.

In FY 1983 NEDO Annual Report.

Research and development was performed for a system suitable to private houses as part of efforts for developing solar cell utilization technology. These activities include comparison between systems with and without a battery, study of system design parameters, such as annual electric energy generation and power generation efficiency of the system, collection and analysis of data concerning voltage variations and harmonic components at the joint between the solar and power systems -- technical points in running the linked systems, study of the power generation characteristics and durability of roof panel type solar cells, and improvement based on the data obtained through field tests on the linked-system protecting equipment. The annual electric energy generation from the 3 KW class system was 2197 KWh. The study showed that the system with a battery has large values of dependence on solar energy and autonomic solar energy supply, whereas the system without a battery has higher systme power generation efficiency and system utilization rate. The voltage variations at the joint between the linked systems were 1% or less. The roof panel type solar cell array has optimum output of 1.973 KW with a flux of solar radiation on tilted plane of 0.86 KW/m^2 at a panel temperature of 58.3°C. (5 tabs)

21330 (NEDOJ—8401, pp 307-313) **Photovoltaic power system for collective housings.** Aug 1984. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770050/JAW.

In FY 1983 NEDO Annual Report.

Verification tests were conducted on the 22 KWp phtovoltaic power generation system for collective housings. These tests helped clarify technical problems involved in systems which are already in practical application stage, and evaluate the economic characteristics of such system. Also, data about various conditions, in which the system was run, was collected, and analyzed for the optimal system configuration. The phtovoltaic power generation system started verification operation in April, 1983, and is supplying electric power to an aggregate residence successfully. Some improvements were implemented to enhance the system efficiency. One of the improvements is the constant-voltage inverter activation circuit attached to the charging-discharging control circuit; this activation circuit allows discharging to start when the battery voltage reaches a preset value; as a result, the time the inverter begins to be activated is 1 to 2 hours earlier; this reduces the period during which generated power is discarded because the battery is fully charged; the system efficiency has been greatly enhanced. (3 figs, 1 tab)

21331 (NEDOJ—8401, pp 314-320) **Photovoltaic power system for school buildings.** Aug 1984. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770050/JAW.

In FY 1983 NEDO Annual Report.

The system installed in 1982 consisting mainly of a 20 KW solar cell, an orthogonal converter (120 KVA), and a secondary battery (288 KWh) was started in August, 1983. Improvement of elemental equipment and system performance was performed. For the orthogonal converter, improvement was done on the gate amplifier and on the control circuit so that the system can properly respond to system variations. For the charging controller, hysteresis characteristics were provided to protect the secondary battery from overcharging and overdischarging; improvement was done on the sequence circuit for the electromagnetic contactor which closes the output terminals of the solar cell array, in order to protect the secondary battery from overcharging. (2 figs)

21332 (NEDOJ—8401, pp 321-327) **Photovoltaic power system for factories.** Aug 1984. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770050/JAW.

In FY 1983 NEDO Annual Report.

This program aims to study composition of an optimum system, installment of the solar cell array and experimentation, and development of elemental machines. Results of study during 1980 - 82 are as follows: (1). Correlation of the power output with amount of sun light and time of sun light was checked. The power output is roughly proportional to the amount of the sun light, and the coefficient varies as much as twice by the season (summer versus winter). Utilization factor of the solar cell did not change although the charging time was changed from 20-hour system to 9-hour system. (2). 100 KWp solar cell array consists of 36 sets of an array (in 5 blocks) with approximately 3 KWp capacity. Improvement of solar energy dependency was aimed by arranging 20° for the array inclination and 20° for the directional angle. (3). Based on the experimental result on the mini-system, a direct current control equipment consisting of a rectifier, a DC/AC/DC converter, and a remote control panel was produced. (7 figs, 1 tab)

21333 (NEDOJ—8401, pp 328-333) **Centralized type photovoltaic power generation system. Study on dispersed array type.** Aug 1984. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770050/JAW.

In FY 1983 NEDO Annual Report.

Based on the design made by 1982, a photovoltaic power generation system, consisting of a 50 KW self-excited inverter, a simulated electric wiring unit and a simulated load unit, was manufactured and installed. The system was operated continuously in 1983 giving the following characteristics. Average amount of sunlight on the horizontal surface (3.58 KWH/m^2-day), average amount of sunlight on the inclined surface (3.42 KWH/m^2-day), solar cell efficiency (roughly 6%), inverter efficiency (roughly 70%) (separately-excited type 65.2%, self-excited type 72.4%), system efficiency (roughly 4%), and equipment utilization (roughly 7%). In 1984, a 100 KW capacity system was completed and was practically tested although partially. Equipment added were a 65

KW solay cell array, a 50 KW self-excited inverter, a simulated electric wiring unit, and a simulated load unit. (4 figs)

21334 (NEDOJ—8401, pp 334-339) **Centralized type photovoltaic power generation system. Study on centralized array type.** Aug 1984. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770050/JAW.

In FY 1983 NEDO Annual Report.

In 1983, a 200 KW-class solar generation system with a 1,000 KWH storage battery unit was completed. This system consists mainly of a storage battery room, a control room, a solar cell array stand (627 m long; 33.9° inclination). and a solar cell panel (208 KWp, 4,785 panels). Power generation characteristics of a solar cell is influenced by temperature. Direct current voltage for attaining a maximum efficiency is subject to a seasonal change(summer to winter). The conversion efficiency of a solar cell abruptly changes at the boundary figure of the amount of the sunlight (10 mW/cm^2). Required amount of the sunlight for obtaining an effective output at the sending end for operating an inverter is 16 - 17 mW/cm^2 for the 45 KW class system and 6 mW/cm^2 for the 200 KW class system. A 97% conversion efficiency of the inverter can be expected at the output of 80 KW (40% load). Amount of the sunlight at Saijo area is 1,505 KWH/m^2 which is much more than that at Tokyo area (1,240 KWH/m^2). (1 fig, 1 tab)

21335 (NEDOJ—8401, pp 340-342) **Centralized type photovoltaic power generation system. Environmental study on water-surface installation.** Aug 1984. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770050/JAW.

In FY 1983 NEDO Annual Report.

Based on the survey on the surface area of water reservoirs in the country, potential capacity of power generation (on the inland water) was estimated. The estimated sum was approximately 3 million KW. For a model district at the inland water area, an estimate was made for the systeme with capacity of 20 KW, 200 KW and 1,000 KW respectively. Estimated power output of AC by inverter was 23.3 MWH, 253.9 MWH, and 1,315 MWH per year respectively. Concerning the solar cell module located on the sea, its structure and material must be carefully examined for preventing the damage from the waves and the sea-salt. Hanging type of power transmission was found more appropriate than the submerged type transmission. DC power transmission was found more ecanomical than AC transmission especially in the higher capacity region than 20 KW. Reduction of cost was aimed for the floating body mooring system by utilizing ready-made steel pipes.

21336 (NEDOJ—8401, pp 343-349) **Development of solar-thermal hybrid type photovoltaic power generation system.** Aug 1984. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770050/JAW.

In FY 1983 NEDO Annual Report.

This study has been conducted since 1974. Light focusing type hybrid unit: A system with the capacity of 30 KWp output (electricity output 5 KWp, heat output 25 KWp) was developed during 1981 and 1982, which was installed at Saka-machi, Hiroshima Prefecture. The system was test-operated for one year with the results as follows. A part of the solar follow-up unit was amended as danger of the strong wind which would move the unit was anticipated. As for the piping system, heat radiation loss was observed due to the degradation of the insulating material. This loss was reduced to less than half by the proper reairing. Vibration caused by the rotation of a turn table was corrected as well as a flow meter. Solar dependency was 33.1% for the electric system and 78.7% for the heat system. A long-term continuous operation with no operator was attained. (1 fig)

21337 (NEDOJ—8702, pp 154-158) **Research and development of photovoltaic power generation system. Research, development and demonstration of system connection control.** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770076/JAW.

In FY 1986 NEDO annual report (Part 2).

This report describes FY 1986 results of demonstration and research of techniques for connecting a small photovoltaic power system with an existing power system. Facilities for demonstration test of 200 kW systems are planned to be constructed in the Rokko test plant of kansai Electric Power Co., Ltd. They consists of high-voltage receiving apparatus, simulated distribution lines and 100 photovoltaic power systems of 2 kW, and incorporate various model load patterns in ordinary homes, including those of simulated high- and low-voltage loads. The facilities can also be used for demonstration and testing of distribution line protection techniques and operation management techniques. A PWM self-excitation type inverter is adopted for photovoltaic power generation. First-phase test facilities of a 40 KW capacity are constructed. It is revealed that a 2 KW small inverter can permit stable operation at a maximum 90% orthogonal transformation efficiency, power factor of 95 percent or more and current distortion factor of 10 percent or less. Safety devices for emergency are developed with satisfactory performance. A device for preventing reverse charge to the distribution line which can be automatically actuated in a few seconds is constructed. Testing of existing small-scale photovoltaic power generation systems (7 units, 21 KW) and testing for secular deterioration of amorphous solar cells are continued. (3 figs)

21338 (NEDOJ—8702, pp 159-163) **Study on photovoltaic power systems. Development of system for school.** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770076/JAW.

In FY 1986 NEDO annual report (Part 2).

School-use photovoltaic power plant systems, as one of solar cell utilization techniques, were examined in 1986 fiscal year. A system containing two 100 KW solar cells units installed on the ground adjacent to Tsukuba University could be operated at the rated output with stability for a long period, revealing the possibilities of 23 x 10^3 KWh yearly generation energy, 10% higher than the designed energy. The discharge energy is 279 KWh at the electric battery discharge depth of 48% which is sufficient for emergency. For charge necessary in the university, the optimum combination is one of 100 KWh soar cells and 288 KWh capacity electric batteries. Increase in the load resulted in the utilization percentage of the solar cells above 90%. A slight weathering was found for the A system of the solar cell arrays, and a reduction in the output for the B system, which necessitated examination on the constitution. For an primary school in Tsuchiura City (1000 pupils), from the charge pattern and the solar radiation, the combination of 150 - 160 KWh solar cell, and 800 - 1000 KWh electric batteries is optimum. (4 figs)

21339 (NEDOJ—8702, pp 164-168) **Study on photovoltaic power systems. Development of system for plant.** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770076/JAW.

In FY 1986 NEDO annual report (Part 2).

Development of industrial photovoltaic plants was made in 1986, for establishment of solar cell utilization technique. A 100 kWp plant was operated for demonstration. The solar energy dependence was 21.6 - 41.3%. As the operating voltage was fixed on the rating which was higher than the optimum one, the photovoltaic conversion (generation power / rated output / sunlight radiation to inclination) was remarkably reduced in August. In case of the auxiliary system being pulsated, the operation of solar cells at a voltage lower than the standard, dependently on the fill factors, lessens a reduction in the photovoltaic conversion. The output of the amorphous silicon solar cells measured prior to the installation was practically useless, and exhibited abnormalities in the output per 1 Wp. The tilt array is different from the pyronometer in the direction of the module, and the spectrum sensitivity. For the tilt array, the year-averaged output presented a maximum near the 27 degree inclination. (2 figs, 4 tabs)

21340 (NEDOJ—8702, pp 169-173) **Study on photovoltaic power systems. Development of dispersed stand-alone system for mountainous and remote areas.** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770076/JAW.

In FY 1986 NEDO annual report (Part 2).

This report describes the results in FY 1986 of investigation for developing a photovoltaie power system for mountainous and remote areas. The field test operation of the system has been continued with no troubles. The output energy of the solar cells was 4279 kWh, which was 109% of the schemed value. The fuel cells as

an auxiliary electric source compensated for the power shortages in the rainy and the winter season, supplying the monthly-average load-demand above 235 kWh continuously. The waste heat from the auxiliary electric source was used to dissolve sufficiently the covering snow on the array surface, and also heat the living water. Improvement in the control system saved the generated power by 13%. The contamination of the array surface led to about 5% reduction in the output. The year output was maximized by setting the action voltage on 146 V. The operation efficiency in winter can be enganced by proper utilization of the array-surface snow-dissolving equipment. The yearly-averaged correlation factor between the inclination solar flux and the increase in the solar cell array temperature was 0.977.(1 fig, 1 tab)

21341 (NEDOJ—8702, pp 174-178) **Study on photovoltaic power systems. Development of dispersed stand-alone system (radio substation system).** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770076/JAW.

In FY 1986 NEDO annual report (Part 2).

This paper describes the results of the investigation in FY 1986 for developing a photovoltaic radio substation system. The solar array, installed on the cold, snowy mountains in Hokkaido, is durable to the natural environments i.e., at the temperature of -30°C, and the wind speed of 60 m/sec., and can generate an excess power. The solar cell module can generate power effectively even in the low solar flux conditions, and has a high resistance to snowing and lighting. The power equipments are durable to cold, snowy environments. A 4.2 kVA engine electric generator was equipped with the system which had the effective output of 36 kW and the battery rated output of 360 kWh. The trial operation from December to March had no troubles, indicating the possibility of long period operation of the system. For the power balance, the system could supply a required power, making the operation of the engine electric generator unnecessary. The array output was in the range of 36 - 54 V, and supplied with high stability to the radio equipments through a stabilized power supply.(2 figs, 1 tab)

21342 (NEDOJ—8702, pp 179-181) **Study on photovoltaic power systems. Development of dispersed stand-alone system (tunnel lighting system).** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770076/JAW.

In FY 1986 NEDO annual report (Part 2).

This report describes the results of investigation in FY 1986 for developing a photovoltaic tunnel lighting dispersed-power system. Sixty four 90 W low voltage sodium lamps were mounted in Meotoura Tunnel of Nichinan - Arai Line, Miyazaki Prefecture. The tunnel is 121 m long and 6 m wide. For the solar cell array capacity, the lighting load was set on 15.6 kWp, and the control load on 2.3 kWp. The lighting was done at 200 V d.c. power. The array d.c. output was high frequency converted through an inverter in the most part for lighting, while a part of the output was stored in the electric batteries. A 69.4 kWh electric battery was installed for load-managing the power supply, and maintaining the night power. In consideration of the solar electric energy and the battery capacity, a new light-controlling system was developed. By the system, the road-surface illuminance and the number of sodium lamps were controlled in consideration of the solar electric energy and the battery capacity, so that the illuminance in the tunnel corresponds to that out of the tunnel. Economical design of the solar cell array and the battery system is realized. Setting of the tunnel illumination system was completed in March, 1986. (1 fig)

21343 (NEDOJ—8702, pp 182-186) **Study on photovoltaic power systems. Development of dispersed stand-alone system (power supply system for remote island areas).** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770076/JAW.

In FY 1986 NEDO annual report (Part 2).

This report describes the results of investigation in FY 1986 for developing a power system for remote island areas utilizing photovoltaic electric generation. The effective output of the array was 161 kWh/day. The photovoltaic power was maximized so that the surplus power and the diesel-engine compensating generation was minimized, by optimizing the control range of the battery retaining electric quantity, and levelling-charging (overcharging) with the solar power. No problems on the salt resistance, and anti-corrosion of the system equipments were found under the unmanned operation. The temperature compensation coefficient for the array output was determined from the module temperature changed with the passage of time. The output of the system was calculated from the practical inclination solar flux, and was compared with the practical monthly-averaged value (the battery retaining electric quantity Ah $\geqq$ 90%). The result has revealed that the energy loss due to the difference of the practical output voltage to the optimum action voltage was 4 - 5%, as anticipated. The charge voltage was more or less higher than the set value, due to the automatic levelling-charging by the solar power. The charge and discharge efficiency was 85.7%, in contrast to 86.6% of the electric batteries not levelling-charged. (1 fig, 2 tabs)

21344 (NEDOJ—8702, pp 187-191) **Study on photovoltaic power systems. Development of dispersed stand-alone system (seawater desalination system for remote island areas-electrodialysis).** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770076/JAW.

In FY 1986 NEDO annual report (Part 2).

This study deals with development of a seawater electrodialytical desalination system for supplying drinking water to the remote islands utilizing a solar power plant as an electric source. The data on solar flux, power generation, load consumption energy, and productivity of drinking water were arranged and examined. The imperfect utilization of the solar flux indicates the necessity for selecting the optimum conditions for the system. The efficiencies of the apparatus, i.e., the solar cells, the electric batteries, and the electro dialytical equipment were higher than the set values, respectively. An additive 10 m^3 intermediate-concentration water tank was installed, and the salt concentration set value was changed for enhancement of the utilization efficiency of the solar cell output, and also increase in the drinking water productivity. For the demonstration plant, the productivity in FY 1986 was 3.4 m^3/day, satisfying the set value of 3.2 m^3/day. A questionnaire was sent out to 670 districts in the remote island and peninsula areas which are under examination for applying the developed combined system. The result has revealed that 100 districts have experienced shortage of water, and 100 districts have problems on water quality. (3 figs, 1 tab)

21345 (NEDOJ—8702, pp 192-196) **Study on photovoltaic power systems. Development of dispersed stand-alone system (seawater desalination system for remote island areas-osmosis).** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770076/JAW.

In FY 1986 NEDO annual report (Part 2).

This study deals with development of a system of seawater osmosis desalination for remote island areas and agricultural-process water-supply. The demonstration system, installed in Hosojima, was simulated for examination. The yearly-averaged generated electric energy was 76 kWh/day, and the consumed energy 72 kWh/day. The calculated water productivity was 5.5 m^3/day in the first step, and 4.9 m^3/day in the second. This amount had a high balance with that required for hydropholic water of 4.5 m^3/day. The generated output was 30.8 kWp (power range of 10-100 kW) for the solar cells, and 840 Ah for the electric batteries. The generated direct-current power was supplied to the loads without use of a DA converter, which contributes to the high energy efficiency and the inexpensiveness of the system. This system can be unattendantly operated in the normal conditions. After construction of the demonstration plant, the respective units and the total system were adjusted to give good results. (1 fig, 1 tab)

21346 (NEDOJ—8702, pp 197-201) **Study on photovoltaic power systems. Development of dispersed stand-alone system (offshore system).** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770076/JAW.

In FY 1986 NEDO annual report (Part 2).

This report describes the results of investigation in FY 1986 for developing an offshore power supplying system utilizing solar cells as an electric source for the offshore operation. A concrete barge of 16 m diameter and 3.5 m high was made to float on the sea, and 264 solar cell modules were placed thereon. The electric battery capacity was 1200 Ah. The maximum output of 24 sets of

the subarrays was 410 W, a converted value at the solar flux of 1 kWh/m², and the element temperature of 28°C. The higher temperature of the elements on the sea than on the ground reduced the subarray output by 3.4%. A data transmission system was developed for grasping the operation of the offshore system. By the system, a required power is supplied through the electric batteries in the night time, and through the solar cell array in the day time, when a generated excess energy is charged into the electric batteries. The averaged solar cell efficiency was 8.9%, a lower value than the set one. This is to the influences of the surrounding constructions, and is a problem to be solved. For the system energy efficiency, the ratio of the load supply energy to the array received solar energy was 0.7%. (2 figs, 1 tab)

21347 (NEDOJ—8702, pp 207-211) **Study on photovoltaic power systems. Development of dispersed stand-alone system (wood-fuel hybrid system).** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770076/JAW.

In FY 1986 NEDO annual report (Part 2).

Development of a solar-wood fuel combined system as a dispersed solar generation system for remote areas was made in 1986. This system, installed in Natural Club Center in Mizukubocho, Shizuoka Prefecture, contains a 5 kWp solar cell array, a 1 kW wood-fuel power plant, and, a 175 kWh electric battery system. The inclination solar-flux ratio (inclination solar flux/all-weather horizontal solar flux) was within +- 5% of the set value. The array efficiency (solar cell output/inclination solar flux array area) was 9.0% averaged from June to December, substantially as planned. The energy sent directly to the loads was 30%, and that to the electric batteries was the remaining 70%, based on the total energy by the solar cell and wood-fuel combined generation. For the total energy, the output ratio of the solar cell array to the wood-fuel power generation was 90:10, which means such operation of the wood-fuel power plant as schemed, compared with the yearly averaged set ratio of 87:13. (1 fig, 2 tabs)

21348 (NEDOJ—8702, pp 212-213) **Photovoltaic power generation system technology. Investigation on utilization system.** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770076/JAW.

In FY 1986 NEDO annual report (Part 2).

This study, started in 1986, deals with investigation on solar electric energy utilization systems for houses and apartment buildings. Further examination on the results in the investigation reports, the survey, and hearing from the scientific personnels were made. Based on the results, it is recommended that the solar dependence of the houses should be as high as possible, and an anti-flow to commercial systems, parallel combined system should be adopted. Further, for the apartment buildings, a combined system switchable to the commercial system in which a solar power is supplied to the loads in the department buildings in the daytime should be adopted. Manuals for the practical application were prepared, which describes solar flux data, demand data, calculation method for electric energy, design examples, and concerned regulations. For standardizing the system evaluation, the comparative evaluations such as efficiencies of solar energy utilization, power generation, storage and conversion, total efficiency, solar energy dependence, power generation per unit area, and so forth were set. The advisory committees and forums were held, from which useful discussions, advices, and suggestions were obtained.

21349 (NEDOJ—8702, pp 448-450) **Study on practical application of new dispersed power plant technique.** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770076/JAW.

In FY 1986 NEDO annual report (Part 2).

Technical subjects for combining fuel cells, photovoltaic power plants and so forth with the existing power systems are analyzed and demonstrated. In 1986, based on the investigation results in 1985, the following analysis and examination were made. For revealing behaviors of the power systems combined with the dispersed power plants, observed when the combined power systems are provided with the conventional protective relays against troubles in the distribution lines, the equipments for a dispersion power plant, developed by NEDO, were simulation-analyzed. An outline of a safety-communication system, and a communication control system were designed, i.e., for disconnecting the dispersed power plants from the system for working at interruption in the distribution lines. A simulation program is prepared, which comprises a program for analysis of voltage distortion, voltage regulation, load-flow, and tansient phenomena, and a data file system, and tested on the functions, for revealing electric phenomena of the combined system under operation. (1 fig)

21350 **Utility intertied photovoltaic system islanding experiments.** Stevens, J. (Sandia National Labs., Albuquerque, NM). pp 1134-1138 of Nineteenth IEEE photovoltaic specialists conference, 1987. (Conference Record). Piscataway, NJ; IEEE Service Center (1987). (CONF-870528—).

From 19. IEEE photovoltaic specialists conference; New Orleans, LA, USA (4 May 1987).

An important factor in the integration of small distributed photovoltaic (PV) systems into a utility grid is that these systems automatically disconnect from the utility in case of a utility outage. This assures that the utility line is not energized by the PV system when it is thought to be deenergized, thus avoiding a situation which could be dangerous to both utility personnel and the general public. There is a dramatic difference between a power conditioner's ability to sense a utility fault and to sense a circuit which has been opened under non-fault conditions. In the case of a fault, the associated voltage excursion is adequate to achieve PCS disconnect. Opening without a fault is a much more subtle event for the PCS to recognize. This paper compares the results of tests of PV system automatic disconnect features performed by Sandia National Laboratories and those designed and executed by four utility companies under Sandia technical direction.

21351 **Residential utility connected systems.** Kern, E.C. Jr. (Ascension Technology, Inc., Lincoln Center, MA 01773). pp 1007-1011 of Nineteenth IEEE photovoltaic specialists conference, 1987. (Conference Record). Piscataway, NJ; IEEE Service Center (1987). (CONF-870528—).

From 19. IEEE photovoltaic specialists conference; New Orleans, LA, USA (4 May 1987).

Starting in 1976 Massachusetts Institute of Technology has contributed to the development of roof-mounted photovoltaic systems for residential, utility connected applications. This work progressed from the first grid-interconnected PV system at the University of Texas at Arlington in 1978, to the planning of DOE's Residential Photovoltaic Applications Project in 1979 and the establishment of three Residential Experiment Stations in the early 1980's. This work culminated in 1986 with the establishment of the Gardner Model Photovoltaic Community Project of the New England Electric System comprising thirty residential systems clustered in a single neighborhood to study the effects of a high concentration of distributed PV generation. This paper reviews the development of residential PV systems at the Northeast Residential Experiment Station (NERES), the best designs identified, their costs and reviews and the best prospects for such systems to contribute to U.S. electricity supply. Early experience from the New England Electric System project in Gardner, regarding times and costs involved in the installations and energy production are included to define the state-of-the-art in residential PV system design.

21352 **Utility compatibility of nonisolated residential power conditioners.** Bower, W.I.; Schalles, F.T.; Key, T.S. (Sandia National Labs., Albuquerque, NM 87185). pp 1122-1127 of Nineteenth IEEE photovoltaic specialists conference, 1987. (Conference Record). Piscataway, NJ; IEEE Service Center (1987). (CONF-870528—).

From 19. IEEE photovoltaic specialists conference; New Orleans, LA, USA (4 May 1987).

Nonisolated power conditioner (PCS) designs can improve the efficiency of grid-connected photovoltaic (PV) systems. They can provide material-intensive hardware with process-intensive hardware, promising cost reductions in future PCSs when they are produced in large quantities. Several technical issues have been studied to ensure that the nonisolated, or transformerless, utility-interactive designs can be used. The technical issues include possible dc injection into the utility or local loads, unbalanced output, and limited options for array protection and grounding. Two nonisolated prototypes have been developed as part of the DOE PV

program and are being evaluated at Sandia National Laboratories. This paper describes the results of the development and evaluation efforts.

1407 Solar Thermal Power Systems

21353 (NEDOJ—8401, pp 350-363) **Development of solar thermal power plant. Management and operation of a pilot plant .** Aug 1984. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770050/JAW.

In FY 1983 NEDO Annual Report.

In pursuit of the technical and economic possibilities of the solar thermal electric power system, test operations were performed on pilot plants of a distributed receiver system and a central receiver system. The project started in 1977 when basic specifications were designed, followed by field surveys. In 1978, the factory was constructed, and installation of the systems and construction of the plant were completed in 1980. In 1981, No. 1 (central receiver system) and No. 2 (distributed receiver system) plants started research operation finishing the operation in March 1984.

21354 (NEDOJ—8401, pp 364-399) **Development of solar thermal power plant. Study on distributed receiver system.** Aug 1984. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770050/JAW.

In FY 1983 NEDO Annual Report.

To investigate technical and economic possibilities of solar thermal electric power plant, development of a solar thermal electric generating system by heliostat-curved surface mirror method and its component devices was planned, and the following items were studied: (A) Reserach on the characteristics using the pilot plants: Measurement results of the plant's component devices and the data obtained from the plant operation were analyzed and evaluated to study the technological properties of the solar thermal power generation system and the component devices. (B) Development of materials for component devices: Conceptual design of the future plant was studied aiming principally at low cost. In the current conceptual design, the specifications of the actual plant were determined by using a light weight devices and molten salt heat storage devices of sensible heat type employed as the solar concentrator and heat collector, and the cost-reducing effect was also evaluated.

21355 (NEDOJ—8401, pp 400-458) **Development of solar thermal plant. Study on central receiver thermal power generation.** Aug 1984. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770050/JAW.

In FY 1983 NEDO Annual Report.

For developing an optimum system and equipment for pursuing technical and economic possibilities of central receiver type solar power generator the following project has been executed. 1) Study of characteristics using pilot plants: (a) By analyzing overall efficiency, data for efficient utilization of the equipment were obtained. (b) Performances of the solar concentrator, solar collector and other systems were checked. (c) Analysis of the overall plant: Each component system of the plant was measured for various modes of operation utilizing the heat storage system, to obtain data for the total simulation and analyze characteristics of the plant. (d) Durability: Tracking accuracy of the heliostat, efficiency of the heat absorber, absorption rate of the absorbing surface, working rate of each devices were checked with the passage of time to get data for durability forecasting. 2) Study for the improvement of system performance: The design materials and operation results up to the previous year were arranged to make the data for practical application of the system. (26 figs, 18 tabs, 4 photos)

21356 (NEDOJ—8401, pp 459-471) **Solar system technology for industry. Study on a cascaded heat process system.** Aug 1984. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770050/JAW.

In FY 1983 NEDO Annual Report.

Dyeing process was selected as a typical example of industrial processing which requires heat control of phased temperature levels. The objective was to develop an optimum energy generating system which requires minimum amount of auxiliary energy through an efficient and stable use of solar heat. To this end, periodical fluctuation of the performance values of the solar collector made in 1982 were measured as basic data to back up the operation of the actual system. Furthermore, a heat exchanger for waste heat recovery was produced, and the software for an optimum operation cotrol technique was developed and tested on the actual system. construction of the plant proceeded with the production of a thermal energy storage tank, a heat exchanger, pumps, and the foundation works of facilities and pipings, etc. By using the system testing device, experimental operation was also made to check the performance of the high-temperature solar collector system. (2 figs, 2 tabs)

21357 (NEDOJ—8401, pp 472-489) **Solar system technology for industry. Study on a fixed heat process.** Aug 1984. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770050/JAW.

In FY 1983 NEDO Annual Report.

As a typical example of the industrial process which needs heat control in order to maintain always the predetermined temperature, a constant temperature warehouse was selected for the subject of this study. With the aim to develop a constant temperature warehouse which minimizes consumption of supplementary energy by supplying the solar energy efficiently and in a stable manner, during the period of 1980-1982, the construction of an agricultural constant temperature warehouse (total floor area-858m^2; inhouse conditions- temperature 15°C, relative humidity not more than 50%) which was to be built in Miyazaki City was started after its basic plan and the basic as well as detailed designs were made. The detail design and test manufacture of freezer, collector, thermal storage and dehumidifier etc. were finished and the simulation programme for designing a constant temperature system and the behavior simulation programme of the system thus designed were both developed. In addition, the control system was developed. In 1983, the entire research facilities of the constant temperature warehouse were completed. Works concerning installation and heat-resisting were both finished. Machines and instruments were all installed and the software for measurement was further developed. Various examinations were performed by exercising the overall test run and overall adjusting run of the warehouse. (3 figs, 3 tabs)

21358 (NEDOJ—8401, pp 490-509) **Solar system technology for industry. Study on underground heat storage system.** Aug 1984. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770050/JAW.

In FY 1983 NEDO Annual Report.

To develop the underground heat storage system well for commercial application in terms of performance and cost and to establish the design and operation methods, studies were started in 1983. The soil was dug vertically by 12m and two soil heat-storing water tanks of the same size were constructed 7m apart by the PB construction method and installation works of equipment and piping etc. were also done. One tank with lining of 10cm thick insulation material was planned for a short term use and the other which utilizes the surrounding soil as heat storage has no lining and was planned for a medium/long term use. These two are to be compared. As for a heat collecting system, the main is a solar collector system which is supplemented by a boiler. Measuring instruments are to be installed in order to obtain exactly the volume of heat to be put into the storage and that to be taken out of the storage and computer analysis of the data concerned is also to be made. (16 figs, 1 tab)

21359 (NEDOJ—8401, pp 510-526) **Solar system technology for industry. Study on a chemical reaction type heat storage system as long term heat storage technology .** Aug 1984. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770050/JAW.

In FY 1983 NEDO Annual Report.

In order to develop a long term heat storage system utilizing chemical reaction heat which uses metal hydride heat storage material, the following developments were made in 1983 to develop technology for industrial and other solar heat systems; (1) Having investigated the effects concerning hydrogenizing characteristics of such alloys as $CaNi_5$ and $LaNi_5$ etc., a good prospect was obtained about the maintenance of alloys' characteristics in connection with the process of mass-production and cost-down of the alloys con-

cerned. (2) Concerning metal hydride container and heat exchanger which are necessary for the test manufacture of a primary test heat storage tank, the basic study and simulation were made and favorable results were obtained. It was found that aluminum alloy fin elements are indispensable for heat storage tanks and heat-pump systems. Based on the results, a primary test heat storage tank was designed. (3) Specifications of various equipment concerning heat storage tanks were determined. Basing thereon, the control methods, most suitable for manual operation of the primary test heat storage tank, were chozen and the basic study of automatic control was also accomplished. (10 figs, 1 photo)

21360 **(SAND—86-8186) 10 MWe Solar Thermal Central Receiver Pilot Plant remote operation feasibility study.** (McDonnell Douglas Astronautics Co., Huntington Beach, CA (USA)). Jan 1988. Contract AC04-76DR00789. 106p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88005562/JAW.

This report describes the results of a feasibility study for remote operation of the 10 MWe Solar Thermal Central Receiver Pilot Plant located near Barstow, California. The plant, called Solar One, is a cooperative activity between the Department of Energy and the Associates: Southern California Edison, the Los Angeles Department of Water and Power, and the California Energy Commission. This report provides a description of the changes required to the plant and a rough cost estimate for the changes.

21361 **(SAND—87-1497C) Performance evaluation of molten salt thermal storage systems.** Kolb, G.J.; Nikolai, U. (Sandia National Labs., Albuquerque, NM (USA); Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V., Koeln (Germany, F.R.)). Sep 1987. Contract AC04-76DP00789. 15p. (CONF-880420—1). NTIS, PC A03/MFA01; 1; GPO Dep. Order Number DE87014645/JAW.

From Testing and measurement in solar energy systems; Denver, CO, USA (10 Apr 1988).

The molton salt thermal storage system located at the Central Receiver Test Facility (CRTF) was recently subjected to thermal performance tests. The system is composed of a hot storage tank containing molten nitrate salt at a temperature of 1050°F and a cold tank containing 550°F salt with associated valves and controls. It is rated at 7 MWht and was designed and installed by Martin Marietta Corporation in 1982. The results of these tests were used to accomplish four objectives: (1) to compare the current thermal performance of the system with the performance of the system soon after it was installed, (2) to validate a dynamic computer model of the system, (3) to obtain an estimate of an annual system efficiency for a hypothetical commercial scale 1200 MWht system and (4) to compare the performance of the CRTF system with thermal storage systems developed by the European solar community. 4 refs., 4 figs., 2 tabs.

21362 **(SAND—88-8103) Development of a mobile heliostat mirror washing system.** (Foster-Miller, Inc., Waltham, MA (USA)). Feb 1988. Contract AC04-76DR00789. 89p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88006932/JAW.

This report describes the development, design and fabrication of an experimental system for washing heliostats. The economics of heliostat cleaning, the design requirements and the design and testing of the wash system are discussed. The heliostat wash system was designed to wash the heliostats located at the 10 MWe Central Receiver Pilot Plant located near Barstow, California. The plant, called Solar One, is a cooperative activity between the Department of Energy and the Associates: Southern California Edison, the Los Angeles Department of Water and Power, and the California Energy Commission. 12 figs., 4 tabs.

1408 Ocean Energy Systems

21363 **(ANL/OTEC-TM—6) A review and critique of the socioeconomic impact assessment for the Kahe Point Ocean Thermal Energy Conversion (OTEC) facility.** Bowen, R.; Gopalakrishnan, C.; Samples, K. (Hawaii Univ., Honolulu (USA). Dept. of Agricultural and Resource Economics). Jan 1988. Contract W-31109-ENG-38. 35p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88005780/JAW.

This report addresses the adequacy of Ocean Thermal Corporation's socioeconomic impact assessment of its 40-MWe closed-cycle ocean thermal energy conversion (OTEC) pilot plant proposed for Kahe Point, Oahu, Hawaii. The socioeconomic impacts identified as relevant to the plant were assessed in detail, including potential economic-demographic, public-service and fiscal, ocean-use, aesthetic, cultural, and energy impacts. The economic-demographic impact assessment does not estimate the full extent of population and income changes or second-order effects associated with the plant. There is no subjective assessment of perceptions on the part of local communities concerning probable changes in land values, housing, and population. Anticipated public-service and fiscal impacts are found to be relatively unimportant; however, the measurement of the impact of the plant on tax revenues needs improvement. The assessment does not sufficiently consider the objective and subjective assessment of ocean-use, aesthetic, and cultural impacts, which are of major significance to the local communities. The quantification of physical impacts, perceptions of impacts, and potential mitigation measures is inadequate. The energy impacts need to be updated to reflect the recent declines in oil prices and price projections. An assessment of low-probability, high-risk occurrences may be necessary. 12 refs., 3 tabs.

1409 Solar Thermal Utilization

REFER ALSO TO CITATION(S) 21816

21364 **(AD-A—187612/7/XAB) Solar receiver-reactor with specularly reflecting walls for high-temperature thermoelectrochemical and thermochemical processes. Technical report.** Steinfeld, A.; Fletcher, E.A. (Minnesota Univ., Minneapolis (USA). Dept. of Mechanical Engineering). 27 Oct 1987. 39p. (TR—11). NTIS, PC A03/MF A01.

A new kind of receiver-reactor for high-temperature solar furnaces is proposed. The main body of the receiver component is an ellipsoid of revolution with specularly reflecting inner walls. The reactor component, a crucible, is placed at one focal point and the aperture at the other. With this arrangement, substantially all of the incident radiation from the concentrator should reach the reactor directly or after one reflection from the cavity walls. An analysis of the radiative exchange among the surfaces is presented. The analysis provides a tool for a parametric study and optimization of the design. It is found that, in contrast to that of conventional well-insulated cavity receivers, its collection efficiency is not very sensitive to the size of its aperture.

21365 **(AFME—85-91-1006) Energy. National utilization in greenhouses.** Sevila, F. (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). 1986. 1071p. (In French). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88752269/JAW.

An experimental greenhouse test facility have been designed and constructed by the CEMAGREF in Montpellier (France). The main objectives of this facility are the measure and optimization of the technological characteristics of the greenhouse and plant environment in order to achieve the best growth conditions and energy utilization: two systems for the dehumidification of the indoor air (heat pump and natural ventilation) are developed and a direct leaf temperature sensor is described and analysed.

21366 **(NEDOJ—8702, pp 236-240) Solar system technology for industry. Cascaded heat process.** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770076/JAW.

In FY 1986 NEDO annual report (Part 2).

This study aims at developing an optimum energy system for dyeing process, selected as a typical industrial process requiring heat-control of the cascading temperature levels, in which system the use of auxiliary energy is minimized by use of solar energy. The performances of the '82 year type and the general type high temperature solar collectors, installed in the demonstration plant in FY 1983, were eventually evaluated, and the changes in the performance with the lapse of time were examined. The solar collection efficiency attained the target sufficiently. The examination on the changes in the performance with the lapse of time revealed that the reflection board manufactured was distorted by averaged 8 degree. Evaluation on the cascade control in the middle and low temperature range, which is a center of the optimum operation control, has revealed that the optimum operation control gives about 4% increase in the collected energy in one year. The demonstration plant was operated successively from FY 1985. The ratio of the secondary load-supplied energy to the solar flux was about 10%, as planned. (5 figs, 1 tab)

21367 (NEDOJ—8702, pp 241-245) **Solar system technology for industry. Fixed heat process system (drying system by solar air collection).** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770076/JAW.

In FY 1986 NEDO annual report (Part 2).

This study aims at developing an industrial drying system with target heat efficiency above 50% and the cost below 50,000 yen/m utilizing an effective solar air collecting system, by optimization of the system construction and cost minimization. For drying wood, two drying chambers with 11 m^3 per one chamber were provided. The heat collecting area of the solar collector was determined to be 112 m^2 by computerized simulation. The result of the demonstration test has revealed that the temperature of about 50°C in the drying chamber can be ensured, attaining the target above 40°C sufficiently. For the drying velocity, the target that the water content should be reduced below 20°C in ten days could be substantially attained. Based on the results of the operational investigation, wood drying was computerized-simulated. The obtained drying speed was in high agreement with the measured value in the upper trays where the inter-wood hot-wind velocity is relatively low. While a significant difference therebetween was found at the initial drying in the zone where the inter-wood speed was high. (4 figs, 1 tab)

21368 (NEDOJ—8702, pp 246-250) **Solar system technology for industry. Advanced heat process system (high performance solar refrigeration system).** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770076/JAW.

In FY 1986 NEDO annual report (Part 2).

For practical application of a solar refrigeration storehouse system, a solar collector, a absorption refrigerator, and a low-temperature thermal-energy storage equipment are developed, aiming at realizing a temperature of 0 - 5°C in the storehouse, and the pilot plant is built. This study, which started in 1984, has delt with design, production and operation of an absorption refrigerator and a solar collector. For construction of a pilot plant, Kitanakagimura in Okinawa Prefecture was selected. In 1986, based on the precedent test results, a vacuum glass tube solar collector and a low temperature thermal-energy storage equipment were developed, and mounted to the pilot plant in Okinawa Prefecture. The pilot plant, of which the system was regulated to the various field conditions, was completely constructed in March, 1987. The pilot plant contains 294 high-temperature solar collectors (solar collection at 140°C). The absorption refrigerator has the refrigeration capacity of 45,000 Kcal/h. The internal volume of the storehouse is 402 m^3. The plant is used for preserving vegetables. Hereafter, performance of each apparatus, control of the system and so forth are to be studied by the successive plant operation. (4 figs)

21369 (PB—88-135579/XAB) **Use of a bare steel shed roof as a solar air heater (for crop drying). Special report.** McLean, D.I. (Council for Scientific and Industrial Research, Pretoria (South Africa). National Building Research Inst.). 1986. 52p. (NBRI-SP-BOU—81). NTIS, PC E06/MF E06.

North American Continent sales only.

Methods of estimating the various performance data required in the design of a solar air heater for crop drying, namely hourly insolation levels, temperature rise through the solar collector, power output, and pressure loss through the collector are discussed. The accuracy is measured against the results found in an actual bare steel shed roof used as a solar air heater, on a farm near Bapsfontein, Transvaal. For all but the pressure loss, the methods propounded were found to give good results under the appropriate conditions. The document is aimed at Department of Agriculture Extension Officers and engineers and is not a layman's (farmer's) guide.

21370 (PB—88-138003/XAB) **Passive solar energy research: the South African scene.** van Wamelen, J.; Higgs, F.S.; Page-Shipp, R.J. (Council for Scientific and Industrial Research, Pretoria (South Africa). National Building Research Inst.). Jun 1986. 12p. (R/BOU—1397). NTIS, PC E04/MF E04.

North American Continent sales only.

A review is presented of the passive solar energy research conducted in the Republic of South Africa, mainly at the National Building Research Institute. The work has progressed from purely empirical observations to a more theoretical approach in which computer modeling plays an increasingly important role. Two experimental house projects are discussed, and some preliminary results are given.

21371 (SERI/TR—250-3263) **Energy Signatures: A passive solar design tool.** Balcomb, J.D.; Lekov, A.B. (Solar Energy Research Inst., Golden, CO (USA)). Dec 1987. Contract AC02-83CH10093. 54p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88001130/JAW.

Energy signatures is a new technique for aiding a designer in selecting and sizing passive solar elements in a building. Hourly heat flux profiles for each candidate design element are determined. These profiles are then matched to the hourly energy requirement of the space accounting for weather conditions, internal heat profiles of the space, and the mass characteristics of the building. Simulation analysis techniques are used to determine the energy signatures and the building load profile, and to check the final result. Least-squares techniques are used to determine the optimum mix of strategies. Examples are given to illustrate development of the method up to the present time. In addition, future directions and possibilities are outlined. 5 refs., 28 figs., 3 tabs.

1410 Solar Collectors And Concentrators

REFER ALSO TO CITATION(S) 21268, 21317, 21366, 21367, 21368

21372 (NEDOJ—8702, pp 251-255) **Solar system technology for industry. Advanced heat process system (high temperature solar energy utilization system).** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770076/JAW.

In FY 1986 NEDO annual report (Part 2).

The study aims at developing an inexpensive, light-weight solar collector for high temperature use (150 - 200°C), and applying the collector practically. In 1985, for each part of the collector, the material, production method, and structure were selected. A curvature moulding machine was developed for mass-production of the mirror panels of the collector. In 1986, improvement of the mirror panel and the absorber, and design and production of a solar tracking system were made. Further, the performance of the combination system was tested. For the structural material of the mirror panel, the paper honeycomb was changed to an aluminum pipe. The heating and cooling cycle test has revealed that the solar collection accuracy can be maintained in such conditions. The absorber and the solar tracking system were improved. For the system of 10 trial collectors arranged in the field, the thermal coefficiency, the heat loss in the solar collection part, and the collected energy were measured. In the case of the collection made at the atomospheric temperature of 10°C, and the heat medium average temperature of 200°C, the efficiency was about 40%. (1 fig, 1 tab)

21373 (NEDOJ—8702, pp 256-261) **Solar system technology for industry. Chemical reaction type heat storage system for long term.** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770076/JAW.

In FY 1986 NEDO annual report (Part 2).

This study aims at developing a bench-scale long period energy storage equipment utilizing metal hydrides as an energy storage material and the chemical reaction heat for practical use of a solar system. By this study, started in FY 1983, the characteristics of metal hydrides to be used as an energy storage material, mass-production method, and production and operation of trial first and second energy storage equipments were examined or evaluated. In 1986, the characteristics of known energy storage materials capable of absorbing and desorbing hydrogen in the high temperature range (90 - 150°C) were evaluated with the aim at improving the characteristics of Ti-Co, Zr-Mn, etc. alloys by multi-component alloying. Novel energy storage materials such as Zr-Mn-Co-Al alloy and the like more suitable for use in the middle and the high temperature range were obtained. The result of the computerized simulation test on the system using the Zr-Mn-Co-Al alloy as energy storage material has revealed that the maximum output temperature is about 130°C. Further, hydrogen transportation and regeneration materials, and hydrogen transfer between an energy storage and a hydrogen storage equipment were examined. (5 figs)

21374 **(PB—88-138425/XAB) Outgassing of sealing and insulation materials in solar collectors.** Eriksson-Widblom, K. (Statens Provningsanstalt, Boraes (Sweden)). 1987. 53p. (In Swedish). (SP-RAPP—1987:27). NTIS, PC E04/MF A01.

One reason for a reduced function in many solar collectors is that the covering plate is fogged by the volatile components in the sealing and insulation products. This so-called outgassing also deteriorates the functions of the components. A method for determination of outgassing was developed within the scope of the project. The sealing and insulation materials used in solar collectors, made in Sweden, were examined and investigated. The results show that outgassing from the products even happens at a temperature used by normal use. With a temperature corresponding to a stagnation situation, e.g., circulation failure, the quantity of volatile components is considerable.

21375 **(PB—88-138458/XAB) Serviceability of sealing materials in solar collectors.** Eriksson-Widblom, K.E. (Statens Provningsanstalt, Boraes (Sweden)). 1987. 55p. (In Swedish). (SP-RAPP—1987:26). NTIS, PC E04/MF A01.

The serviceability of the sealing materials in a solar collector is of great importance. Extensive investigations show that a large number of materials used has an aging durability inadequate to the severe environmental conditions to which the collector is exposed.

21376 **(PB—88-148051/XAB) Concentrating photovoltaic collectors - fabrication design. Final report, 16 December 1986-31 August 1987.** MacPherson, M.R.; Doherty, J.E.; Erbert, V. (Wattsun Corp., Albuquerque, NM (USA)). Oct 1987. 54p. NTIS, PC A04/MF A01.

See also report dated Oct 86, PB—87-119327.

The Wattsun Corporation has developed a concept and prototype for a concentrating photovoltaic collector that has the potential for significant cost reductions over existing commercially-available systems. The concept uses small-lens elements concentrating solar energy on small photovoltaic cells. Modules are less than one inch thick, containing lenses one-half inch square focusing on cells one-eighth inch square. A previous report, NMRDI 2-74-4608, described principles, test results, and cost estimates. The present report discusses experimentation designed to finalize materials selection and fabrication procedures.

21377 **(SAND—87-3078C) Recent advances in photovoltaic concentrator technology.** Maish, A.B.; Boes, E.C. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 8p. (CONF-880457—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003948/JAW.

From American Society of Mechanical Engineers Solar Energy Division conference; Golden, CO, USA (10 Apr 1988).

Photovoltaic concentrator technology is experiencing rapid, significant advances in efficiency, cost and reliability which make it a leading candidate to add to the nation's electrical generating capacity in the next decade. This paper reviews the development path being pursued by the Department of Energy program to achieve its near-term energy cost goals and to transfer this technology to the private sector. The paper summarizes the research status of concentrator cells, components, modules and arrays. System reliability is also discussed in the context of a new reliability program.

1420 Heat Storage

REFER ALSO TO CITATION(S) 21373

21378 **A simplified technique for designing least cost stand-alone PV/storage systems.** Chapman, R.N. (Sandia National Labs., Albuquerque, NM 87185). pp 1117-1121 of Nineteenth IEEE photovoltaic specialists conference, 1987. (Conference Record). Piscataway, NJ; IEEE Service Center (1987). (CONF-870528—).

From 19. IEEE photovoltaic specialists conference; New Orleans, LA, USA (4 May 1987).

A new design technique is presented for stand-alone photovoltaic/storage systems that accounts for the year-to-year variations in insulation and yet requires only the average monthly horizontal insulation as input. The array and storage sizes are governed by the desired loss-of-load probability (LOLP), which represents the fraction of the demand not met during the system's lifetime. The designer can size for any LOLP less than 0.05 and can choose from four sets of array/storage combinations to achieve the desired LOLP. The designer can choose tilt angles from latitude minus 20° to latitude plus 20°. The technique is applicable to any system with a fixed tilt array and for either electrical or product storage. If electrical storage is used, the technique allows the designer to estimate the number of battery replacements required over the system's lifetime.

15 GEOTHERMAL ENERGY

1501 Resource Status And Assessment

REFER ALSO TO CITATION(S) 21421

21379 **(EGG-M—35187) Future for geopressured-geothermal resources.** Ramsthaler, J.; Plum, M. (EG and G Idaho, Inc., Idaho Falls (USA)). 1988. Contract AC07-76ID01570. 19p. (CONF-880103—4). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005635/JAW.

From Symposium on geothermal energy; New Orleans, LA, USA (10 Jan 1988).

The geopressured-geothermal production technologies for recompleting the Hulin Well and design and operation of surface facilities appear to be well in hand. A preliminary capital cost estimate indicates $4.45 million is required to recomplete and prepare the Hulin Well for production testing. The planned recompletion of the production well, surface facilities, and disposal well will have the capability to handle 24,000 barrels per day (bpd) of brine. If the reservoir can produce this design flow of brine saturated with gas, and the gas can be sold for $1.30/thousand cubic feet (mcf), DOE should have a positive cash flow about $530 per day for the first year. If gas zones are located above the brine as indicated by logs, the positive cash flow could reach $4130 per day or higher. The principal uncertainties are the gas content of the brine and the reservoir performance, both initially and long term. A private developer would need a market price for natural gas of from $1.38 to $4.60 per mcf for a reasonable return on investment depending on the reservoir performance and whether or not zones of excess gas are actually encountered. 7 refs., 6 figs.

21380 **(LA—11101-HDR) Hot Dry Rock Geothermal Energy Development Program: Annual report, fiscal year 1985.** Brown, D.W.; Franke, P.R.; Smith, M.C.; Wilson, M.G. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001949/JAW.

The primary objective for the Hot Dry Rock Program at the Los Alamos National Laboratory during fiscal year 1985 was to complete the Phase 2 reservoir connection and to begin flow testing the resulting reservoir. The connection was achieved through redrilling one well and additional fracturing operations, and progress was made toward developing a detailed understanding of the fractured region through a variety of reservoir interrogation methods. Other accomplishments during the fiscal year included improvement of the high-temperature, inflatable, open-hole packer used to isolate sections of the uncased wellbore in collaboration with the Baker Corporation and the design and fabrication of a high-temperature borehole acoustic televiewer in a cooperative program with a research institute in West Germany. Progress was also made in techniques for the collection and analysis of microseismic data. Reservoir-engineering activities and geochemical studies, as well as the more routine support activities, continued in FY85. 18 refs., 15 figs.

21381 **(LA-UR—87-4125) Advanced geothermal technologies.** Whetten, J.T.; Murphy, H.D.; Hanold, R.J.; Myers, C.W.; Dunn, J.C. (Los Alamos National Lab., NM (USA); Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract W-7405-ENG-36. 16p. (CONF-880212—4). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004307/JAW.

From 15. annual energy technology conference and exposition; Washington, DC, USA (17 Feb 1988).

Research and development in advanced technologies for geothermal energy production continue to increase the energy production options for the Nation. The high-risk investment over the past few years by the US Department of Energy in geopressured, hot dry rock, and magma energy resources is producing new means to lower production costs and to take advantage of these resources. The Nation has far larger and more regionally extensive geothermal resources than heretofore realized. At the end of a short 30-day closed-loop flow test, the manmade hot dry rock reservoir at Fenton Hill, New Mexico, was producing 10 MW thermal - and still climbing - proving the technical feasibility of this new technology. The scientific feasibility of magma energy extraction has been demonstrated, and new field tests to evaluate this technology are planned. Analysis and field tests confirm the viability of geopressured-geothermal energy and the prospect that many dry-hole or depleted petroleum wells can be turned into producing geopressured-geothermal wells. Technological advances achieved through hot dry rock, magma, geopressured, and other geothermal research are making these resources and conventional hydrothermal resources more competitive. Noteworthy among these technological advances are techniques in computer simulation of geothermal reservoirs, new means for well stimulation, new high-temperature logging tools and packers, new hard-rock penetration techniques, and new methods for mapping fracture flow paths across large underground areas in reservoirs. In addition, many of these same technological advances can be applied by the petroleum industry to help lower production costs in domestic oil and gas fields. 5 refs., 4 figs.

21382 **(NEDO-OS—8606) FY 1985 annual report. Geothermal energy survey and technology.** (New Energy Development Organization, Tokyo (Japan)). Jun 1986. 234p. NTIS (US Sales Only), PC A11. Order Number DE88770065/JAW.

This report presents results of geothermal technology development and surveys of geothermal energy which were carried out by New Energy Development Organization in FY 1985. In the area of geothermal technology development, studies were made on elemental techniques for various apparatus required in a demonstration plant for 10MW-class, binary-cycle geothermal power generation. Requirements for the location of a demonstration plant are examined from various viewpoints. A downhole pump is developed. An investigation is made of cooled hot water reinjection and physiochemical mechanisms of hot water injection which are required for efficient production of geothermal water. Techniques for preventing the deposition of calcium carbonate scales and those for removing hydrogen sulfide are also studied. NEDO is cooperating with U.S. counterparts under an IEA agreement in carrying out a hot dry rock development project at Fenton Hill. Four model areas were selected and a nationwide geothermal exploration survey was made using various survey techniques to clarify the conditions of geothermal energy over the nation. Studies including well surveys are performed in the Sengan and Kurikoma areas to provide data required to establish prospecting techniques for deep geothermal resources. Development of an effective method for terrestrial magnetism measurement is currently under way. (65 figs, 15 tabs, 10 photos)

21383 **(NEDO-P—8518) Preliminary studies of resources for domestic hot dry rock program (Part 2).** (New Energy Development Organization, Tokyo (Japan)). Mar 1986. 198p. (In Japanese). NTIS (US Sales Only), PC A09. Order Number DE88770059/JAW.

Some prospective wells having potential hot dry rock (HDR) resources are chosen and quantitative evaluation of the resources is carried out based on the results of the Preliminary Studies of Resources for Domestic Hot Dry Rock Program implemented in the preceding fiscal year, and also based on deep drilling data disclosed later. And information helpful for selection of candidate testing sites is presented. For wells with a depth of 1,000 m or more and an average geothermal gradient of 10°C/100 m or more, an examination is made of the suitability of rocks and the influence of faults. Rocks with an average effective porosity of 5% or less are regarded as hopeful. Seventeen wells are selected as prospective ones. It is found that the resource reserves (heat potential) range from 10s to 100s of 10^{12} kcal for the shallow hot rocks which occur at depths from a 250 °C-reached level down to 3 km, while the value ranges from 100s to 1,000s of 10^{12} kcal for the deep hot rocks at depths of 3 to 5 km. Study results have suggested that the prospective areas for resources development include Hachimantai, Takamatsudake and Hijiori and that these areas also contain hopeful candidate spots for HDR testing sites. Further studies are required before making the final selection. (59 figs, 21 tabs, 42 refs)

21384 **(NEDO-P—8520) Fundamental studies of the binary cycle electric power generation.** (New Energy Development Organization, Tokyo (Japan)). Mar 1986. 207p. (In Japanese). NTIS (US Sales Only), PC A10. Order Number DE88770054/JAW.

Investigations of resources are carried out to obtain information that verifies the usefulness of downhole pumps for the binary cycle electric power generation system. The first step is to assess the regional medium-high temperature geothermal water resources. For this purpose, eight areas, for which a relatively large volume of data are available, are selected, and the suitability and the reserves of geothermal water in these areas are calculated. Results reveal that each area contains geothermal resource base of the order of 10^9 tons. The requirements for reservoirs of geothermal resources for this system, taking economic restrictions into account, include a temperature of 150 to 200°C at a depth of about 1,000 m, existence of a static level at a depth of 200 m or less, and a productivity index of 10 ton/h/kg/cm^2. As candidate sites, 13 areas that meet the requirements are selected. The further required studies are carried out to determine whether these and additional areas are practically suitable for the operation of the system. (57 figs, 29 tabs, 38 refs)

21385 (NEDOJ—8401, pp 531-546) **Comprehensive survey of nationalwide geothermal resources.** Aug 1984. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770050/JAW.

In FY 1983 NEDO Annual Report.

Since the exploitation of concealed geothermal resources has not been made positively in Japan, there is a need to exercise a wide area exploitation in order to grasp without delay the geological and geomorphological conditions of the geothermal resources in whole Japan. In order to cope with this matter, surveys by radar-image process and Kurie plot process are introduced for the exploitation of the geothermal resources. Also gravity process survey, effective in determining the size and structure of the geothermal re-

sources as well as the images from the Landsat satellite are added thereto for analysis through which the promising areas are chozen. Thus effective exploitation and development plans are to be provided and the latest prospecting technologies can be established. With the above aim, radar-image process surveys were made nationalwide and at the same time surveys applying Kurie plot process and gravity process were performed during the period of 1980-1982. In 1983, the data of Kurie plot process surveys (Southern Oart of Tohoku, Kanto, Tokai, Chugoku, and Shikoku) and the data of gravity process surveys (Hokkaido, Southern Part of Tohoku, Kanto, Central Mountain, Kinki, and Chugoku) were obtained, processed and analysed. In addition, the analysis of the data (Kanto, Chubu, Kinki, Chugoku, Shikoku, and Northern Part of Tohoku) was done for acessing promising areas. Nationalwide (except Kyushu) maps of the promising for geothermal resources are under preparation. (12 figs)

21386 (NEDOJ—8701, pp 239-260) **Nationwide geothermal resources survey.** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A14. Order Number DE88770075/JAW.

In FY 1986 NEDO Annual Report (Part 1).

This report describes 1986 results of the nationwide geothermal resources survey. A dominant geothermal fluid reservoir exists at deep portions extending from eastern Iwaonupuri to Goshiki Hot Spring and reaching Yumoto Hot Spring in the Niseko area, which contains a volcanic geothermal system. The reservoir, whose temperature is above 240°C, ranges along a deep fissure existing at an altitude of -1,000 m to -2,000 m. In the Kokubu area, the heat source is residual magma associated with the Kirishima volcano and the Aira caldera and the temperature of the reservoir is 100-250°C. In the Hakkoda area, a reservoir exists at a depth of greater than 1,000 m and its temperature is 260-280°C. The Minami-Aizu area, a promising high-temperature area, consists of two sections. One contains caldera-related springs at Onnohana, Kifu, etc., while the other contains hot springs at Oku-Kinu, Kawamata, etc. The latter is expected to contain a dominant geothermal system with a reservoir of above 200°C existing at a depth of about 2 km. A heat source evaluation system previously designed is applied to the evaluation of the geothermal potentials of the geothermal systems in these four areas. (11 figs)

21387 (NEDOJ—8701, pp 261-276) **Geothermal development promotion survey.** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A14. Order Number DE88770075/JAW.

In FY 1986 NEDO Annual Report (Part 1).

This report describes FY 1986 results of the geothermal development promotion Survey, which has been conducted by the New Energy Development Organization in promising geothermal areas untouched by the commercial sector. In the 70 km² Toyou area, a high-temperature band of 300°C exists at a depth of 1,500 m along Yunosawa. In the 70 km² Minami-Kayabe area, there is a high-temperature zone of a maximum 184°C on the east of Mt. Nakitura. The 75 km² Yuda area contains a high-temperature zone, with the Yukawa hot spring at its center, whose depth and temperature are 1,500 m and a maximum 159°C, respectively. The 50 km² western Unzen area contains a high-temperature zone and the temperature near the Unzen hot spring is 230-250°C. In the 70 km² Kamikawa area, a high-temperature band of 241°C exists at 1,600 m along the Shiromizu river. The 70 km² Otaki area and the 70 km² Hisazumi area contain a high-temperature zone of 64°C at 1,290 m and of a maximum 192°C at 1,700 m, respectively. In 1986, new surveys were started in the areas of Yagumo (70 km²), Minase (70 km²) and Inawashiro (70 km²). (10 figs)

21388 (NEDOJ—8701, pp 277-279) **Investigation for promotion of geothermal development. Development of evaluation method for geothermal reservoir rock.** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A14. Order Number DE88770075/JAW.

In FY 1986 NEDO Annual Report (Part 1).

For rational estimation of geothermal energy capacity, optimum power plant scale, etc., development of reservoir rock evaluation methods was made in 1986. The geothermal-system three-dimensional reservoir rock simulator (1) was improved and extended for determination of the geothermal system reservoir rock in spontaneous state, and calculation of the after-production rock behaviors under condition of no two-phase flow. The two-phase flow reservoir rock simulator (2) was improved and extended for determination of the two-phase reservoir rock, in which hot water and natural steam co-exists, in spontaneous state, and calculation of the after-production rock behaviors under condition of a two-phase flow generated. For analysis of characteristics of the formaroles, the in-well two-phase flow simulator was improved and extended. Based on the digged well-survey data in Kirishima district, a quantitative model of the rock in spontaneous state was prepared by the simulator (1). Based on the observation well survey data in Sumikawa district, a quantitative model of the rock in spontaneous state was prepared by the simulators (1), (2). A crude design of simple small and middle scale geothermal power plants was made. (2 figs)

1502 Geology And Hydrology Of Geothermal Systems

REFER ALSO TO CITATION(S) 21422

21389 (LBL—24324) **Combined seismic and hydraulic method of modeling flow in fractured low permeability rocks.** Witherspoon, P.A.; Long, J.C.S.; Majer, E.L.; Myer, L.R. (Lawrence Berkeley Lab., CA (USA)). Jun 1987. Contract AC03-76SF00098. 34p. (CONF-8706137—2). NTIS, PC A03. Order Number DE88004551/JAW.

From NATO advanced research workshop on advances in analytical and numerical groundwater flow and quality modeling; Lisbon, Portugal (2 Jun 1987).

Modeling flow of ground water in hard rocks where a network of fractures provides the dominant flow paths is a major problem. This paper summarizes a program of investigations currently underway in this laboratory to characterize the geometry of fractured rocks and develop methods of handling flow in such systems. Numerical models have been developed to investigate flow behavior in two- and three-dimensional fracture networks. The results demonstrate the insights that can be gained from modeling studies of fractured rocks. A key problem is gathering the necessary data on fracture geometry. Investigations have been started to determine how vertical seismic profiling (VSP) might be improved and applied to this problem. A VSP experiment in The Geysers geothermal field in northern California, where fracture orientation is known, produced shear wave splitting and velocity anisotropy in agreement with theory. The results suggest the potential application of 3-component, multi-source VSP data in determining fracture orientation and average spacing. We believe a combination of seismic and hydraulic methods can greatly enhance an understanding of fluid flow and transport in low permeability rock systems where fractures provide the dominant paths. 40 refs, 16 figs., 4 tabs.

21390 (NEDOJ—8701, pp 205-214) **Development of binary-fluid system. Research on production and injection of geothermal water (Study on mechanism of underground injection of geothermal water).** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A14. Order Number DE88770075/JAW.

In FY 1986 NEDO Annual Report (Part 1).

This report describes results of a study performed in 1986 on the mechanism of underground injection of geothermal water in a binary-fluid system. A reservoir concept for the Onikobe area, which is of a vapor-water mixture type, is developed and examined. It is suggested that in the Onikobe area, a Cl -type geothermal water comes up from a deep underground level while H_2S gas resulting from gas-liquid separation at a shallow level dissolves into ground water, leading to the production of a SO_4^{-2} type hot spring. The productivity, injection factor, inflow depth, outflow depth, fumarolic fluid temperature reservoir pressure, hydraulic conductivity, etc., are investigated and analyzed for each well. The fumarolic fluid flows in two phases into the No.111 and No.129 geothermal wells. Exploratory wells are found to be rather stable, with no change in pressure with time at the same depth. The tracer technique is used to observe the behaviors of injection geothermal water in the reservoir. Re-spouting occurs in no geothermal wells except for the No.127 well. A model of reservoir behaviors is developed and a simulation study is performed. (3 figs)

21391 (NEDOJ—8701, pp 215-219) **Development of binary-fluid system. Research on production and injection of geothermal water (Development of optimum technique for production of geothermal water).** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A14. Order Number DE88770075/JAW.

In FY 1986 NEDO Annual Report (Part 1).

This report describes a study for the development of optimum geothermal water production techniques, carried out in 1986 in pursuit of effective utilization of geothermal water for geothermal power generation. A production technique is developed to be used at the production phase in areas with high-temperature geothemal water. Pressure calculations based on a reservoir model agree with those based on analysis of a one-dimensional flow. An arrangement is made to allow the average flow rate and length of the passage of injection water reaching the geothermal well to be estimated from the concentration of tracer which comes out of the geothermal well after being added to the injection well. In case of a modification in the operation plan to be made after the start of power generation operation, a method is developed to determine the optimum injection rate based on available power. A model is constructed to predict the behaviors of a reservoir which exists in a weak self-flowing type area and requires a geothermal well pump. Overseas surveys are made in philippines, which has the world's second largest capability, and Indonesia, which has large potential for future, to determine the reservoir mechanism and post-development behaviors. (1 tab)

1503 Geothermal Exploration And Exploration Technology

REFER ALSO TO CITATION(S) 20966

21392 (NEDOJ—8401, pp 547-557) **Verification surveys of geothermal exploration technology.** Aug 1984. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770050/JAW.

In FY 1983 NEDO Annual Report.

In order to establish exploitation technology applicable to large scale deep geothermal resources distributed in a wide area by compilation of the exploitation technologies of geothermal resources which have been accumulated so far, Sengan Area, the thermal model with caprocks and Kurikoma Area, without caprocks were chosen for the following surveys; (1) Sengan Area—Surface surveys applying refraction process, electromagnetic process and electrical process were made. Also fifteen wells 200m deep each and two wells 400m deep each were drilled and geothermal flow survey and geological dating were performed. Apart from that, one well 1500m deep was drilled and well loggings etc. were performed about it. This well was further dug to 2000m and the knowledge about the geological structure was obtained (1981-1982). In 1983, digging of three 1500m wells was started. Two of them were completed and various well loggings were done about these two. (2) Kurikoma Area—Color distribution maps of soil temperature were prepared and surface surveys by electromagnetic process etc. were done. One 1500m well was dug and well loggings were performed (1980-1981). Digging of a 1500m well which had been suspended in 1982 was resumed in 1983. (6 figs, 2 tabs)

21393 (NEDOJ—8701, pp 280-316) **Confirmation study on the effectiveness of prospecting techniques for deep geothermal resources.** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A14. Order Number DE88770075/JAW.

In FY 1986 NEDO Annual Report (Part 1).

For establishment of geothermal exploration techniques, the results of exploration in the two model districts were certificated by well surveying in 1986. For the geothermal structure in Sengan area, the 800 m well survey reveals that a geothermal field extends in the east and west directions centering around Yakiyama and Hachimantai volcanoes. The area is characteristic of the calderas formed by the acidic volcanic rock stream in the tertiary period. The geothermal source is due to the diagenesis in the tertiary period. The Sengan area is abundant in geothermal resources in the deep underground. The 1500 m well survey in Kurikoma area reveals that volcanic gases exit in KR-1, 2 well, and the temperature equilibrium is 270°C in KR-3 well at 1300 m depth and 316°C in KR-4 at 1390 m depth. The south-east district in Onikobe geothermal field has prospect geothermal resources. The geothermal districts are divided in an upper-stream type as in Katayama district, and a down-stream type. The geothermal source is due to the volcanic activities in Takahinatayama. A high precision magnetotelluric survey was developed, and practically tested. (24 figs, 1 tab)

1505 Economic And Financial Aspects

REFER ALSO TO CITATION(S) 21379

1506 Environmental Aspects And Waste Disposal

REFER ALSO TO CITATION(S) 21382, 21413

21394 (NEDOJ—8401, pp 570-583) **Study on the reinjection of geothermal water. Reinjection of the low temperature water.** Aug 1984. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770050/JAW.

In FY 1983 NEDO Annual Report.

The following tests were carried out in order to clarify the damping mechanism of the reinjection wells in the case of the underground reinjection of low-temperature geothermal hot water already utilized for a binary cycle power generation. (1) Water passage test by a testing equipment in simulation of the reinjected earth layers: Various combinations of such factors as hot water characteristics, type and particle size of the filler, and temperature of the simulated column were adopted. Evaluation was made by checking the water passage time, amount of scale adhered, amount of the hold-up, and reduction of water permeability coefficient. (2) Fundamental test: Fundamental behavior of the scale stuffing was checked by means of a constsnt water level simulation column wherein the coefficient of water permeability and the amount of the scale hold-up could be measured. (3) Reinjection test by an actually drilled well: Water with 80 °C and 50 °C temperature was tested by reinjecting into the observation well and the reinjection well respsctively. Measurement was made on the capacity of reinjection and the pressure in the wells. (5 figs)

21395 (NEDOJ—8401, pp 584-593) **Study on the reinjection of geothermal water. Survey on the subterranean reinjection mechanism of thermal water.** Aug 1984. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770050/JAW.

In FY 1983 NEDO Annual Report.

An experimental study for an optimum production and reinjection system was made in Nigorigawa and Takinoue districts. The behavior of the reinjected hot water is as follows: (1) Study by the observation wells revealed almost no change in the level and temperature in the well, from the values measured prior to the power generation. (2) A tracer was thrown into the well and was checked for the existence in the spouting well. Respouting from the production wells was confirmed. (3) A simulation was carried out and flow behavior of water in the reservoir was clarified including a heat balance. Influence of the reinjected thermal water underground is as follows: (a) Frequency distribution of the earthquakes was prepared and calculations were made on the source, magnitude, and the energy evolved. It was found that the production and reinjection give no influence to the activity of the minute earthquakes. (b) Influence of the production and reinjection of the thermal fluid on the ground was not observed in spite of the fact that a certain variation in the amount and direction of changes were found. (1 fig)

21396 (NEDOJ—8401, pp 601-605) **Development of technology for removing hydrogen sulfide in geothermal power plant.** Aug 1984. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770050/JAW.

In FY 1983 NEDO Annual Report.

The objective of this research is, as the preparation for future large scale geothermal power generation, to develop technology and facilities for the removal of emitted hydrogen sulfide with high removal rate (over 90%) and for the recovery of sulfur as element sulfur. The study started in 1977, and analysis of hydrogen

sulfide concentration, chemical components, etc., study on dealing method with geothermal fluid, field tests, construction of a prototype of continuous measurement facility for hydrogen sulfide, and installation and demonstration test of the pilot plant was performed. The diffusion system and RET system were tested and demonstrated in 1983. The designing scheduled for 1983 was made, and modification based on field investigation and construction of devices were performed. Continuous measurement equipment applicable for demonstration tests was developed and chemical analysis method was also employed.

21397 (NEDOJ—8701, pp 197-204) **Development of binary-fluid system. Study on production and injection of geothermal water (Reinjection of low-temperature geothermal water).** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A14. Order Number DE88770075/JAW.

In FY 1986 NEDO Annual Report (Part 1).

This report describes results of a study performed in 1986 on injection of low-temperature geothermal water in a binary-fluid system. Collective geothermal water and flow line geothermal water taken at Otake are passed through a scale-model apparatus at various temperatures and using different filler materials. The water pass time decreases with decreasing temperature of geothermal water. Collective geothermal water at Hacchobaru is not affected by temperature. Otake injection water shows a minimum in water pass time at 60°C. The water pass time increases with decreasing pH. A model for numerical calculation for predicting the attenuation of injection wells is developed taking into account various factors in scale deposition, such as pH, silicic acid concentration and temperature of geothermal water. An injection demonstration test shows that the hydraulic conductivities of 242 (No.1 well) and 91 (No.2 well) at the start of injection decreases to 0.8 and 4 at the end, repectively. This is attributed greatly to the effect of the deposition of silica scale occurring in strata, instead of silica scale deposition at exposed pipe portions in boreholes. A greater attenuation in injection performance occurs at higher injection temperature. (6 figs)

21398 (NEDOJ—8701, pp 317-320) **Survey for safety of large-scale depth-geothermal power plant from environmental impacts.** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A14. Order Number DE88770075/JAW.

In FY 1986 NEDO Annual Report (Part 1).

By using sampling and injection of a geothermal fluid in a deep and wide geothermal area, environmental impacts in Toyoha district were surveyed for 1978 - March, 1987. The geologic structure and ground surveys, and the depth resistivity surveys by MT method (magnetotelluric survey) were conducted. The underground survey was made by 1500 m structure drilling, 3000 m survey and injection well injection, and well logging. A large amount of a high temperature and pressure fluid was sampled, and injected for surveying the environmental impacts on and under the ground. The new surveying techniques such as MT method, etc. were effective. The chemical properties of the depth geothermal fluid exerted no particular influences on the environments on and under the ground. (1 fig, 1 tab)

1508 Geothermal Power Plants

REFER ALSO TO CITATION(S) 21382

21399 **(EGG-M—10887) Overview of recent activities in the Heat Cycle Research Program.** Bliem, C.J.; Mines, G.L. (EG and G Idaho, Inc., Idaho Falls (USA)). 1987. Contract AC07-76ID01570. 7p. (CONF-8704110—15). NTIS, PC A02. Order Number DE88005544/JAW.

From 5. geothermal program review; Washington, DC, USA (14 Apr 1987).

The Heat Cycle Research Program, which is being conducted for the Department of Energy, has as its objective the development of the technology for effecting the improved utilization of moderate temperature geothermal resources. To meet this objective, the program has as one of its goals to improve the performance of geothermal binary cycles to levels approaching the practicable thermodynamic maximum. In pursuit of this goal, tests are being conducted at the Heat Cycle Research Facility located at the DOE Geothermal Test Facility, East Mesa, California. The current testing involves the investigation of binary power cycle performance utilizing mixtures of non-adjacent hydrocarbons as the working fluids, with supercritical vaporization and in-tube condensation of the working fluid. In addition to the present test program, preparations are being made to investigate the binary cycle performance improvements which can be achieved by allowing supersaturated vapor expansions in the turbine. These efforts are anticipated to verify that through the utilization of these advanced power cycle concepts and allowing the supersaturated turbine expansions, improvements of up to 28% in the net geofluid effectiveness (net watt hours plant output per pound of geofluid) over conventional binary power plants can be achieved. Results presented for the recent testing, including those tests examining the performance of the countercurrent condenser at different tube inclinations, support the assumptions used in projected performance improvements. 3 refs., 9 figs.

21400 **(EPRI-AP—5600) Downwell pump reliability: Geothermal experience update: Final report.** Ellis, P.F. (Radian Corp., Austin, TX (USA)). Jan 1988. 151p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920184/JAW.

Geothermal resources with temperatures between 250° and 360°F (121°C and 182°C) are prime candidates for binary-cycle power generation, and constitute about 80% of the power-capable resources in the United States. The successful exploitation of these resources requires reliable high-capacity downwell brine production pumps, but earlier experience showed that high-capacity, high-temperature geothermal production pumps had many problems which resulted in a mean time-to-failure (MTTF) of less than 1000 h. However, steady progress has been made since 1981, and a large body of experience has been acquired by three geothermal binary plants. This survey of high-temperature geothermal downwell pump users and manufacturers updates a prior survey (AP-3572) completed in early 1983. This survey traces the development of lineshaft pump technology from the late 1970s to the present (mid-1987), detailing the advances in design, materials selection, and operating practices. Case histories of 72 lineshaft pumps installed at three geothermal binary plants since late 1981 are documented, including some detailed cause of failure reports. In the recent past, pump lives in excess of 7000 h have become common, but a high continuing rate of premature failures resulted in a mean time-to-failure (MTTF) of about 5000 h. Based on recent advances which appear likely to eliminate most premature failures, the estimated near-term MTTF will be on the order of 8000 h. The survey found almost no development of high-temperature geothermal electric submersible pumps (ESP's) or close-coupled downwell hydraulic turbopumps, and concluded that considerable development and demonstration will be needed before these technologies are able to compete with existing high-temperature geothermal lineshaft pump technology. 36 refs., 10 figs., 25 tabs.

21401 **(EUR—9532) Development of a di-phasic turbine for production of electricity from the expansion of geothermal brine.** Bussac, F.; Gillant, P.; Sagnes, P.; Schlegel, R. (Commission of the European Communities, Luxembourg). 1985. 223p. (In French). NTIS (US Sales Only), PC A10. Order Number DE88752287/JAW.

The work carried out in this first phase of the development of di-phasic expansion thermal systems, has lead to the following results: - A technical and economic analysis of the process has come up with potential costs (excluding research) varying from 3000 to 6000 francs/kWe for actual, representative sites. - The physics of the di-phasic expansion of brine has been modelled, and a measurement tool for the turbine injectors has been perfected. Trials of different injectors, on a specific bench have enabled the qualification of the influence of different parameters. - A trial turbine has been put in operation on a testing bench conceived and set up in collaboration with the BOUVIER workshops. The net yield, in the present system, is 20% for four injectors and 23% for six. An analysis of the different sources of loss has enabled the description of different techniques for improving performance. The next phase of development, during which these improvements will be put into operation, should make it possible to achieve net yields of between 40 and 50%.

21402 (NEDOJ—8401, pp 558-564) **Development of geothermal hot water power generation plant. Study on elemental technology for binary cycle power generation plant.** Aug 1984. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770050/JAW.

In FY 1983 NEDO Annual Report.

Study on counterplans against corrosion for binary power plants and an optimum cycle of the plants (study on heat media and parallel power generation forms) is carried out which is necessary for the improvement of scale and economical efficiency of the plants. In 1983, a heat loop test device was designed and constructed to test evaporators and condensers with hot water made by electoric heaters and compound media, to simulate geothermal hot water fields. As the result, the following facts became clear. Materials with similar properties to SUS 316 can be applied to acid soil of about PH2-PH3 and materials similar to carpenter 20 which has been considered as most corrosion resisting must be used for soil of PH1. As regards media, the mixture of R114 and R152 is considered to have 25% more output than R114, setting up deoxidation tower, R114 is considered to be applicable in the high temperature of about 140°C. (1 tab)

21403 (NEDOJ—8401, pp 565-569) **Development of binary cycle power generation plant. Design of 10MW class plants.** Aug 1984. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770050/JAW.

In FY 1983 NEDO Annual Report.

For the development of binary cycle plants, a 10MW class binary cycle power demonstration plant for each 130,150 and 170°C of geothermal hot water is designed, and the overall evaluation of the condenser system is carried out. In 1983, the culculation of heat balance and cost of plants was made, and a heat equilibrium graph was completed. Optimum cooling water temperatures at the inlet and outlet of the cooling system were examined. And Outline drawings of turbines, a flow chart of the main pipes for the dual boilling plants and the plant with a parallel steam plants were produced. And binary generation with downhole pumps was also examined. As the result of those studies, the relation between the cost of generation, unit cost of construction, and hot water temperature became clear. (1 fig)

21404 (NEDOJ—8401, pp 606-616) **Research and development of total flow power generation plant.** Aug 1984. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770050/JAW.

In FY 1983 NEDO Annual Report.

In 1979 and 1980, technological research was made for inner seals, uniform supplying method of vapor and water, and expansion of two-phase flow. Then a trial 300 KW class two-phase flow rotary expander was produced. In 1981, facilities were designed, constructed, installed, and operated for two-phase flow to study the performance of the expander. The shaft horsepower of 290KW was achieved as planned, but the engine efficiency was only about 60% of the designed value. In 1982, improvement in the performance and part of the overall evaluation was performed, and basing on the result of the study, a 1000 KW class practical machine was conceptually designed. In 1983, overall evaluation of the two-phase flow roatray expander was made. The 300 KW class trial expander itself can serve well as a small scale practical machine, and there seems to be a good possibility of developing larger scale practical machines based on the trial expander. In the field of geothermal power generation, application of the two-phase flow rotary expander to medium and small scale heat sources was proved to be competitive with the existing turbine system from the viewpoint of efficiency and economy.

21405 (NEDOJ—8701, pp 174-178) **Development of binary-fluid system. Development of demonstration plant of power range 1-10 MW (Study on elemental techniques).** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A14. Order Number DE88770075/JAW.

In FY 1986 NEDO Annual Report (Part 1).

This report deals with the development of a heat exchanger for binary-fluid systems. An equation is derived to determine the heat transfer coefficient of a condenser (hc) within an error of +- 30 percent. The hc for a mixed working fluid is always smaller than that for a single fluid with equal properties, and the heat transfer resistance increases with decreasing vapor velocity. A vertical shell tube type condenser is preferable. A heat transfer equation is developed to determine the heat transfer of an evaporator (he) within an error of +-20 percent. The he for a mixed working fluid is always smaller than that for a single fluid with equal properties. The use of a vertical shell tube is desirable in a range where the temperature difference is small while the use of a conventional evaporator is preferable in a large temperature difference range. The test apparatus is disassembled and checked. Results show that there is only slight fouling. An addive is developed to allow the heat medium R114 to operate at evaporation temperatures around 140°C. Application of a fin tube type heat transfer tube to each of the condenser and evaporator is effective to decrease the size of facilities.

21406 (NEDOJ—8701, pp 179-187) **Development of binary-fluid system. Development of demonstration plant of power range 1-10 MW.** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A14. Order Number DE88770075/JAW.

In FY 1986 NEDO Annual Report (Part 1).

Following 1985, the drilling of exploratory wells and a preliminary resources survey are continued in pursuit of the development of a binary-fluid system. Three test wells (BS-2,3,4) are drilled. BS-2 has extremely high injection factor and hydraulic conductivity of 450 ton/h/kg/cm^2 and 210 darcy-m, respectively, indicating that it is an excellent geothermal well. A band-like low electric conductivity area extending in the NW-SE direction is associated with the paths that supply the geothermal fluid. It is revealed that the production and injection of geothermal fluid have no effect on the consequences of earthquakes or the ground water. Conceptual desigining of an evaporator and heater is carried out, and tests are performed for various materials to determine their properties in hot water, river water and atmosphere.

21407 (NEDOJ—8701, pp 188-196) **Development of binary-fluid system. Development of demonstration plant of power range 1-10 MW (Development of downhole pump).** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A14. Order Number DE88770075/JAW.

In FY 1986 NEDO Annual Report (Part 1).

This report describes results of a study performed in 1986 for the development of a geothermal well pump driven by underwater motors. It is shown that polyimide and FRP has sufficient heat resistance as material for stator coils and that the motors do not produce abnormal vibrations. Repeated heat stress application testing reveals that they have a satisfactory strength to ensure safety. The tandem connection for the two motors shows good water-resistant and insulating performance, and the sealing oil for the motors also has required properties. The cables, connection, support fittings and penetration parts are resistant to hot water. Highly refined mineral oil can work effectively for the bearings and shaft seal parts. An operation monitor is developed for checking the temperature, pressure and vibration. An in-plant test is made using the No.1 test apparatus of 50 ton/h x 3000 m x 100 kW and a 1000-hour continuous operation test is conducted at Kokonoe-cho, Oita Prefecture. Good results are obtained. In carrying out the site test, a program for analyzing the water head and wells in operation is developed. To apply the geothermal well pump, some wells are selected based on evaluation results.

21408 **Geothermal heat cycle research supercritical cycle with horizontal counterflow condenser.** Mines, G.L.; Swank, W.D.; Bliem, C.J. (Idaho National Engineering Lab., EG and G Idaho, Inc., Idaho Falls, ID 83415). pp 924-929 of Proceedings of the 22nd intersociety energy conversion engineering conference. New York, NY; American Institute Aeronaut and Astronaut (1987). (CONF-870804—).

From 22. intersociety energy conversion engineering conference; Philadelphia, PA, USA (10 Aug 1987).

Technical Paper 879379.

The Heat Cycle Research Program, which is being conducted for the Department of Energy, has as its objective the development of the technology for effecting the improved utilization of moderate temperature geothermal resources. To meet this objective, the program has as one of its goals to improve the performance of geothermal binary cycles to levels approaching the practicable thermodynamic maximum. In pursuit of this goal, tests are

being conducted at the Heat Cycle Research Facility located at the DOE Geothermal Test Facility, East Mesa, California. The current testing involves the investigation of binary power cycle performance utilizing mixtures of non-adjacent hydrocarbons as the working fluids, with supercritical vaporization and in-tube condensation of the working fluid. Results are presented for the recent testing including those tests examining the performance of the countercurrent condenser at different tube inclinations. Performance of the heaters and the condenser in a vertical orientation can be predicted well with existing methods and data. The condenser in its near horizontal orientation performs slightly worse than in its vertical orientation. Some problems have been encountered in predicting the performance in the horizontal orientation. There is no evidence of departure from integral condensation in either orientation. Indications to date are that the turbine performs with no degradation in performance when its expansion is "through" the two-phase region.

21409 **Zeotropic mixtures of halocarbons as working fluids in binary geothermal power generation cycles.** Bliem, C.J. (Idaho National Engineering Lab., Idaho Falls, ID 83415). pp 930-935 of Proceedings of the 22nd intersociety energy conversion engineering conference. New York, NY; American Institute Aeronaut and Astronaut (1987). (CONF-870804—).

From 22. intersociety energy conversion engineering conference; Philadelphia, PA, USA (10 Aug 1987).

Technical Paper 879380.

The performance of Rankine cycle binary systems for geothermal power generation using a hydrothermal resource has been investigated as a part of the U.S. Department of Energy, Geothermal Technology Division (DOE/GTD) Heat Cycle Research Program. To date, in addition to many pure fluids, mixtures of Paraffin-type hydrocarbons and water-ammonia mixtures have been investigated. This paper gives the results of consideration of mixtures of halocarbons as working fluids in these power cycles. The performance of mixtures of Refrigerant-114 (R-114) and Refrigerant-22 (R-22) in combinations from pure R-114 to pure R-22 was calculated for such cycles. Various alternatives were considered: 1. minimum geofluid outlet temperature constraint/no constraint, 2. dry turbine expansion/expansion through vapor dome, 3. use of turbine exhaust gas recuperator/no recuperator. Results of the study indicate that the halocarbon mixtures are at least as good as the hydrocarbon mixtures previously analyzed for a 360 F resource. The magnitude of the net geofluid effectiveness (net energy produced per unit mass geofluid flow) for the R-114/R-22 mixtures is the same as for the best hydrocarbon mixture previously analyzed. The percentage improvement in effectiveness in using mixtures over using the pure fluids as working fluids is comparable for both classes of working fluids.

1509 Geothermal Engineering

REFER ALSO TO CITATION(S) 21390, 21397

21410 **(LA-UR—87-3085) The US Hot Dry Rock Geothermal Energy Development Program.** Franke, P.R. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 7p. (CONF-880103—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000523/JAW.

From Symposium on geothermal energy; New Orleans, LA, USA (10 Jan 1988).

Recent accomplishments of the program are highlighted by a successful limited term flow test of the Phase 2 reservoir at the Fenton Hill site near Los Alamos. This reservoir connection was established by sidetracking one of the deep wells into hydraulically fractured areas, identified by microseismic data after original fracture attempts failed to connect the two wells. Hydraulic communication was improved by supplemental fracturing. Preliminary testing indicated a reservoir with fracture volume and heat production area surpassing the values from the earlier Phase 1 reservoir. Following completion of the downhole reservoir system, preparations were made for a reservoir-energy-extraction test. This Initial Closed Loop Flow Test (ICFT) was needed to obtain operating characteristics for planning a much longer test for thorough reservoir evaluation. The 30-day ICFT succeeded with final production of about 10 MWt at 192°C, while injecting 285 gpm at 4600 psi and producing 206 gpm at 500 psi. The water loss rate and flow impedance were high, 27% and 18 psi/gpm respectively, but were declining. Radioactive tracer tests indicated reservoir volume growth during the experiment which was continuously monitored for acoustic or microseismic activity. Following the flow test, experiments were continued for several months during the venting process. Preparations are now underway for the Long Term Flow Test (LTFT). To understand as much as possible about the Phase 2 reservoir and to demonstrate the commercial feasibility of energy from HDR reservoirs, a flow test of approximately one year's duration is deemed necessary. Part of the preparation for the LTFT is the workover and repair of the production well and the installation of a competent overall flow loop and energy exchange system. 7 refs., 5 figs.

21411 **(NEDO-P—8519) Summary of lost circulation technology feasibility study.** (New Energy Development Organization, Tokyo (Japan)). Mar 1986. 171p. (In Japanese). NTIS (US Sales Only), PC A08. Order Number DE88770052/JAW.

A survey is made of measures currently taken for lost circulation in geothermal wells, and technical and economic investigations are carried out in an effort to identify effective techniques. Targets to be achieved by future research and development activities and major problems involved are described. It is shown that all companies surveys have been using almost the same measures and procedures, which basically require experience and intuition of the field personnel. The following were pointed out in an interview survey concerning techniques. Detection of the location of the loss zone is necessary to carry out lost circulation measures effectively and systematically. An expert system (e.g., the artificial intelligence system for lost circulation control under development at Sandia National Laboratories, U.S.A.) should be introduced. It is needed to develop good sealing materials and effective placement methods which can work adequately in geothermal environments in various temperature ranges up to 250°C. The objective of the planned research and development program is established as follows: To solve large-scale lost circulation problems in geothermal wells, systematic lost circulation curing techniques should be established and demonstrated by developing loss zone detection and analysis techniques and by developing optimum sealing materials and placement methods. (82 figs, 18 tabs, 6 photos, 11 refs)

21412 (NEDOJ—8401, pp 594-600) **Development of the downhole pump.** Aug 1984. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770050/JAW.

In FY 1983 NEDO Annual Report.

A downhole pump was developed in order to effectively utilize the geothermal water whose weak spouting power had left it unutilized. (1) Study on the elementary technology: By establishing the specification on the characteristics of the geothermal water and the design conditions on the pumps and the motors, material selection, design and preliminary performance analysis of bearing and shaft-seal were made. (2) Conceptual design of a verification unit: Design items and the basic structure were checked; study on the trial making test units; target value of the test units was set preparing for the future scaling up. (3) Evaluation of the well capacity. Elements for the production capacity of the wells were found to be fluid temperature (T), reservoir pressure (P), depth of flowing-in fluid (L), and production index (J). T counts mostly for the self-spouting capacity of the wells, wereas P, L, and J are only secondary factors. A line-diagram was prepared for the relation between the well exit pressure and the flow quantity. A value of J was studied for 20 domestic geothermal wells. It was found that, although J with less than 10 $t/h\text{-}cm^2\text{-}kg$ was more than 50 %, quite many number of wells showed the higher value indicating that a downhele pump was applicable. (3 figs)

21413 (NEDOJ—8401, pp 617-625) **Development of deep-seated geothermal water supply system. Development of extraction and reinjection system.** Aug 1984. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770050/JAW.

In FY 1983 NEDO Annual Report.

The objective of the project is to develop deep-seated geothermal water, produce models of extraction and reinjection. The

development started in 1980, and drilling of test wells, extraction and reinjection tests, erection of modules, study on the alteration of ground, overall analysis were performed. Demonstration tests for 20 tons/h and 60 tons/h rates were carried out in 1983. The 20 tons/h rate test was made for 60 days in continuation of the test made in the previous year, completing the continuous operation of 365 days in total. The 60 tons/h rate demonstration test lasted for 46 days. The accumulated production was 149,000 tons of hot water, 157,000 m^3 of natural gas, and the accumulated amount of reinjected hot water was 141,200 tons. The temperature of the produced hot water was 68°C. The 60 tons/h rate test proved that production of large amount with a large scale facility is economical. The test results and geological data were arranged for the production of 3 dimensional hydrothermal reservoir model, and computer programs were developed. The ground was checked and confirmed that there had been no ground change. The above results proved that the technology employed for the project for the exploration, drilling, and extraction of hot water could be applicable. (6 figs, 2 tabs)

21414 (NEDOJ—8401, pp 626-639) **Hot dry rock technology development project. Cooperative operation of international energy technology development.** Aug 1984. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770050/JAW.

In FY 1983 NEDO Annual Report.

The targets of the operations are to participate in the U.S. hot dry rock research and development projects, cooperatively develop technology for the production of artificial hydrothermal system capable of generating 20-50 MW heat output, and prove it to be economically justified. In 1977, the first artificial heat extraction loop was completed and successfully tested. In 1981, wells for 20 - 50 MW were drilled in three dimensional intervals as designed. In May, 1982, hydraulic fracturing was started for the construction of an artifical reservoir. Following 10 experiments performed in 1982, a large scale hydraulic fracturing test was made in 1983, but failed in conducting the above-mentioned two wells. A separator was designed and assembled, and additional 9 surface observation stations were established. Vent gas from the wells and all water reservoirs in the area were periodically analyzed for the protection of environment. In the field of reservoir engineering, a great progress was made in the mapping technology for micro-earthquake waves. Theoretical study and indoor experiments were also carried out. Approximately 40 geochemical experiments were made, and the main result was the elucidation of the behavior of montmorillonite in high temperature area. (11 figs, 2 tabs)

21415 (NEDOJ—8603, pp vp) **Study on decrease of reservoir permeability due to deposition of silica dissolved in reinjection water.** Itoi, Ryuichi; Maekawa, Hiroaki; Fukuda, Michihiro; Jinno, Kenji; Hatanaka, Koichiro; Yokoyama, Takushi; Shimizu, Shin. (Kyushu Univ., Fukuoka, Japan; Kyushu Electric Power Co., Ltd.). 1986. (In Japanese). New Energy Development Organization, Tokyo, Japan.

In FY 1986 NEDO Technical Report.

A column made up of alumina beads and rock particles was supplied with geothermal water from the Otake Power Generation Plant (the temperature of the water was constantly 90°C) in order to conduct silica deposition experiments. The findings are as follows: The flow rate decreases with time; it decreases faster when the silica concentration in the geothermal water is higher. When the column is made up only of rock particles, the initial flow rate decrease is faster than when the column material is alumina beads because silica is stuck to rock particles more easily than to alumina beads. Silica deposition is concentrated on the inlet of the column and its vicinity, and the amount of deposit quickly decreases with the distance. The permeability coefficient at the end of injection is very low in the vicinity of the column inlet; however, the reduction is lower when the distance from the inlet is longer. The relation between the amount of silica deposit and the permeability coefficient can be represented by Kozeny-Stein's equation when the secondary porosity of the silica scale is 0.90 to 0.95. (13 figs, 1 tab)

21416 (NEDOJ—8603, pp vp) **Study of silica deposition of geothermal water and parameter identification.** Hatanaka, Koichiro; Jinno, Kenji; Itoi, Ryuichi; Maekawa, Hiroaki; Yokoyama, Takushi; Shimizu, Shin. (Kyushu Univ., Fukuoka, Japan; Kyushu Electric Power Co., Ltd.). 1986. (In Japanese). New Energy Development Organization, Tokyo, Japan.

In FY 1986 NEDO technical Report.

To explain the mechanism of deposition of silica dissolved in geothermal water and the relation between the amount of silica scale and the permeability coefficient, a mathematical model has been proposed. This mathematical model consists of the continuity equations governing the silica and aluminum concentrations, the equations representing how the porosity changes with the increase in the amount of retained silica, the equation representing the relation between the amount of deposition and the peameability coefficient, and the basic flow equation. Study was conducted to identify the adsorption parameters contained in the mathematical model using a least squares method (more accurately, a Karman filter). The calculated values obtained through the study well agreed with measured values. The considerations in parameter identification are attention paid to the change of the amount of deposition with time and computation for obtaining differentials of silica and aluminum concentration and hydraulic potential distributions. In the experiment, geothermal water from the Otake Geothermal Power Generation Plant was used. (11 figs, 3 tabs)

21417 (NEDOJ—8603, pp vp) **Chemical processing and chemicals in geothermal energy development.** Mishima, Atsuo. (New Energy Development Organization, Tokyo, Japan). 1986. (In Japanese). New Energy Development Organization, Tokyo, Japan.

In FY 1986 NEDO Technical Report.

Among various techniques used jointly for geothermal energy collection, this report focuses on the fluid processing sector in the production. When utilizing only the heat of geothermal energy, the main problems are trouble with scale and preservation of environment. When recovering the resources from the fluid components, which is also an important factor, two main problems occur. One is such components contained as pH, hydrogen sulfide, and arsenic, and the other problem is the trouble caused by conditional changes occurring on the fluid when it is taken out. Namely, when the water is collected up to the surface ground from the deep underground at high temperature and high pressure, the water is cooled and released from high pressure, causing deposits and liberation by the oversaturation. This report describes the technical research and development of the method of removing the silica, scale of calcium carbonate and hydrogen sulfide which are generated by such oversaturation. (11 figs, 4 tabs)

21418 (NEDOJ—8603, pp vp) **Preliminary pressure tests at Hijiori SKG-2 Well.** Kobayashi, Hideo; Matsunaga, Retsu; Kosugi, Masayuki; Hayami, Hirohide. (National Research Inst. for Pollution and Resources, Tokyo, Japan). 1986. (In Japanese). New Energy Development Organization, Tokyo, Japan.

In FY 1986 NEDO Technical Report.

Upon executing a large scale hydraulic fracturing for the formation of an artificial geothermal reservoir, it is necessary to secure the characteristics of the rock concerned including existence of natural fractures. Since a large-scale hydraulic fracturing experiment using the already-drilled SKG-2 well at the Hijiori Region, Yamagata Prefecture as a part of the Sunshine Project, preliminary pressure tests were performed in 1985 in order to know the characteristics of the rock concerned which constitute the basic data for the planning of the experiment above. The well has the 7 inch casing from the surface to the depth of 1,802m and this time tests were executed six times against the uncased part of 14m from the end of the casing to the bottom of the well. As the results, it was found that the maximum pressure and the amount of water returned increase as the amount of pumped water flow increases. The mean permeability of the rock on the assumption that the rock concerned is homogeneous was 1.5×10^{-15} ----1.4×10^{-16} m^2, and the permeability of the rock became 1.5----2.2×10^{-17} m^2 on the assumption that a part of the pumped water remains in the well, other part

enters into such water-leak-off layers as already existing fractures etc. and the rest permeates into the rock itself. (3 figs, 1 tab)

21419 (NEDOJ—8701, pp 220-224) **Development of binary-fluid system. Research and development of techniques for preventing lost circulation in geothermal well.** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A14. Order Number DE88770075/JAW.

In FY 1986 NEDO Annual Report (Part 1).

This report describes results of a study performed in 1986 for the development of techniques for preventing lost circulation in geothermal wells. A test is made to evaluate the performance of a well logging instrument which is manufactured by SDI Corp. in U.S. and can make three major measurements, i.e. temperature, pressure and flow rate, simultaneously. Its performance is found to be satisfactory, though some improvements may be required. An well temperature analysis program is developed and an analysis is made to determine the temperature distribution in a lost circulation layer and its effect on the recovery of mud temperature. Development is started to provide a program which can select an optimum sealing technique. Polymers for high-temperature use and artificial light-duty aggregate materials are examined to determine their performance as solid, heat-resistant sealing materials. Performance of a thixotropic cement slurry as a cement-based sealing material is also tested. Polyurethane is a major candidate for chemical sealing material. A study is made on isocianates and polyoles to be used as starting material and curing agent, respectively. Specification of a testing apparatus to be used are set up. Studies are also made on methods for feeding a two liquid mixture type chemical agent, specifications of a sealing simulation apparatus, and tests, researches and other activities currently performed in the U.S.

21420 (NEDOJ—8701, pp 225-238) **Technical development for hot-dry-rock power plant. Development of elemental techniques.** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A14. Order Number DE88770075/JAW.

In FY 1986 NEDO Annual Report (Part 1).

A study is made on creation of an artificial reservoir for a hot-dry-rock power plant, fracture mapping, and feasibility of heat recovery. Six high-pressure pumps are used to make a hydraulic fracturing test for the SKG-2 well at Hijiore, Yamagata Prefecture. Injection of 1,000 m^3 of water successfully creates an artificial reservoir at the well bottom and its location is identified by acoustic emission testing. Opening of the well head after the injection results in the return of about 35 percent of the injected water in the form of hot water accompanied by vapor, indicating that heat extraction is very feasible. During a water injection test at the SKG-2 well, acoustic emission at a depth of 800 m in the SKG-1 well is measured by a triaxial seismic detector. Acoustic emission begins to be detected at a water injection rate of 3 m^3/min. The source of the vibration was 200-400 m to the south of the SKG-2 well and 1,200-1,800 m deep. it is found that no vibrations are detected by a high-sensitivity seismic detector, that no change occurs in hot spring water, and that the water injection test does not affect the environment. (8 figs, 3 tabs)

1510 Direct Energy Utilization

21421 **(LA-UR—87-2734) The direct application of geothermal energy to provide process heat in Guatemala.** Altseimer, J.H.; Edeskuty, F.J. (Los Alamos National Lab., NM (USA)). Sep 1987. Contract W-7405-ENG-36. 18p. (CONF-880104—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE87014723/JAW.

From 11. annual energy-sources technology conference and exhibition; New Orleans, LA, USA (10 Jan 1988).

One part of an energy and resource development program in Central America is a geothermal process heat project in Guatemala. The feasibility of the direct heat application depends upon the production characteristics and reliability of the geothermal source. Other factors are the distance from the heat source, quantity of use, and capacity factor of the use facilities. Favorable conditions would be distances of under 5 km, heat requirements approximately equal to the well capacity, and high capacity factors (say 60% or higher) in the industrial plants. Depending upon the values of these factors, energy costs of less than $1.00/million Btus to greater than $5.00/million Btus have been estimated. This can be compared to about $5.00/million Btus for petroleum-based fuels in Guatemala in mid 1987. A survey was made of existing industries in the Amatitlan and Zunil geothermal areas. In both Amatitlan and Zunil the existing industries are spread out over an area too large to be called an optimum. The most promising situation for an industrial park development is at Amatitlan, except that proven production wells are not yet available. At Zunil, production wells exist, but a diverse nearby industrial base does not. However, both of these two areas are sufficiently promising to merit further development. Consequently, a demonstration project is underway aimed at the ultimate establishment of an agricultural processing center at Zunil. This center would have the capability to process agricultural products by dehydration, freezing, and cold storage. 2 refs., 4 figs., 2 tabs.

1520 Geothermal Data And Theory

21422 **(DOE/ER/13409—1) Geothermal alteration of sediments in the Salton Sea scientific drill hole: Petrophysical properties and mass changes during alteration: Final report.** McDowell, S.D. (Michigan Technological Univ., Houghton (USA). Dept. of Geology and Geological Engineering). 11 Dec 1987. Contract FG02-85ER13409. 64p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88004089/JAW.

This report has been divided into two sections. The first deals with the results of the petrophysical measurements, and the second concentrates on the distribution of alteration minerals and textures, and on a series of calculations of geochemical changes that occurred during alteration. 32 refs., 23 figs., 10 tabs.

16 TIDAL AND WAVE POWER

1607 Tidal Power Plants

21423 **(ETSU-STP—4048(P1)) UK potential for tidal energy from small estuaries. A survey of possible small sites on the West coast.** (UKAEA Harwell Lab. Energy Technology Div.; Binnie and Partners, London (UK)). Jun 1987. 59p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

Based on studies already carried out for the Department of Energy in the UK and other studies abroad, a quick method of assessing the approximate installed turbine capacity, energy output, capital cost and cost of energy has been developed. The method has now been applied to 118 estuaries and embayments located on the west coast of England and Wales and the western part of the southern coast of England. The overall conclusion is that there are tidal power sites ranging over two orders of magnitude in capital cost which have similar predicted unit costs of energy. Consequently, there are small sites which lie at the bottom of this range which offer the prospect of becoming economic in their own right.

17 WIND ENERGY

REFER ALSO TO CITATION(S) 21233

1701 Availability (climatology)

21424 (NEDOJ—8401, pp 658-662) **Analytical investigation of large scale wind power generation system.** Aug 1984. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770050/JAW.

In FY 1983 NEDO Annual Report.

For total analytical evaluation of a large wind power generation system, development of an analytical evaluation method was performed together with analysis and evaluation of various factors regarding large wind power plants, including technology, environment, site selection, resources, utilization schemes, social acceptance, and market. In the investigation conducted in 1983, Rumoi in Hokkaido was selected as a typical strong-wind seashore area in Japan. For 3 months, wind condition was observed in upper atmosphere and at 10 m above from the ground. In addition, cost of a

large wind power generation system was analyzed on the basis of the data obtained through designing and elaborating the 100 kW class pilot plant. The results of the wind condition observation showed that the percentage of appearance of wind speeds available for wind power generation is estimated to be 60% to 65% on the assumption that the cut-in, cut-out, and stational tower wind speeds are 5.0, 18.0, and 10.0 m/s, respectively. The percentage of appearance of the stationary tower wind speed is 20% to 33%. The results of the cost analysis showed that the rated power and rotor diameter most suitable for LWECS are 3000 kW and 80 to 90 m, respectively.

1705 Environmental Aspects

21425 (NEDOJ—8401, pp 654-657) **Environmental assesment regarding large wind power generation plant.** Aug 1984. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770050/JAW.

In FY 1983 NEDO Annual Report.

Large wind power plants have some negative impacts on environment. Measurement and investigation were conducted to evaluate such negative impacts, especially radio wave interference using a 100 KW class wind power pilot plant. Impacts were extracted, and the range of influence were investigated. The pilot plant is at Miyakejima. For environmental assessment, a simulation program for radio wave interference and noise was prepared, and the results obtained by running this program were compared with measured data. They well agreed. The experiment has revealed that there is no reflection interference area, that the shielding distance corresponding to a 1.5 dB shielding loss is 206 m, and that the shielding width is 21 m. Propagation of noise over wind was taken into account in the noise evaluation simulation program.

1706 Wind Energy Engineering

REFER ALSO TO CITATION(S) 21424, 21965

21426 **(ENEA-RT-FARE—87-4) AERODIN - Computer code for the calculation of the aerodynamic characteristics of eolian rotors.** Arsuffi, G.; Caminiti, N.M. (ENEA, Rome (Italy)). Jun 1987. 59p. (In Italian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88751894/JAW.

System behaviour simulation under different conditions is particularly important in wind machine design. Computer codes used to provide this kind of analysis require the aerodynamic characteristics of the rotor over a extended range of tip speed ratio and blade pitch angle values. The Modelling Laboratory of FARE/INPRO Division of ENEA has developed a model and a computer program (AERODIN) to calculate the aerodynamic characteristics of a HAWT rotor. The output is in suitable form for use in simulation models. The AERODIN computer program is described in this report with an explanation of the equation involved and of the solution method used. Numerical examples are included to illustrate the input and show what type of results are obtained.

21427 **(ETSU-WN—5041-P1) Prediction of fatigue damage in wind turbines. Volume 1 of 2: main text and figures.** Warren, J.G. (ed.). (Taylor Woodrow Construction Ltd., Southall (UK); UKAEA Harwell Lab. Energy Technology Div.). Aug 1987. 271p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

A report on the first stage of a development project which has the objective of providing a design tool for predicting fatigue damage of horizontal axis wind turbine generator (WTG) rotors is presented. In attempting to predict rotor fatigue damage it has been necessary to address a problem that appears to be peculiar to wind turbines. It is readily apparent that non-uniformity in the flow field approaching the rotor will induce loads in the turbine structure that vary sinusoidally with time. In addition to these deterministic loads the structure experiences the effect of wind turbulence which is random. The actual load history on a turbine rotor is a combination of both the deterministic loads and the random (stochastic) loads. These two types of load are combined in such a way as to arrive at a realistic estimate of fatigue damage.

21428 **(ETSU-WN—5041-P2) Prediction of fatigue damage in wind turbines. Volume 2 of 2: reference data base figures.** Warren, J.G. (ed.). (Taylor Woodrow Construction Ltd., Southall (UK); UKAEA Harwell Lab. Energy Technology Div.). Aug 1987. 412p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

A report on the first stage of a development project which has the objective of providing a design tool for predicting fatigue damage of horizontal axis wind turbine generator (WTG) rotors is presented. In attempting to predict rotor fatigue damage it has been necessary to address a problem that appears to be peculiar to wind turbines. It is readily apparent that non-uniformity in the flow field approaching the rotor will induce loads in the turbine structure that vary sinusoidally with time. In addition to these deterministic loads the structure experiences the effect of wind turbulence which is random. The actual load history on a turbine rotor is a combination of both the deterministic loads and the random (stochastic) loads. These two types of load are combined in such a way as to arrive at a realistic estimate of fatigue damage.

21429 (NEDOJ—8401, pp 646-653) **Development of large scale wind power generation system. Development of 100 KW class plant.** Aug 1984. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770050/JAW.

In FY 1983 NEDO Annual Report.

The target of this project is to develop a 100 KW class wind power generation system for the practical use. In 1981 and 1982, production of a trial machine, functional test for each element, and functional tests for the combination of the produced devices were carried out. 60 start-stop tests were performed on 100 KW trial machine for 5 - 17 m/s wind power and 0 - rated rotating speeds (51 rpm for low speed shaft and 1500 rpm for high speed shaft). As the result, it was found that the start-up wind speed is close to the designed value, the blade and rotor presented no abnormal vibration, and 0.2°/s at start-up and 0.1°/s at stopping were approapriate as pitch angles. 169 power generation tests were carried out for 5 - 17 m/s wind speeds and 0 - 100 KW power output. The characteristics of the power generation capacity fulfilled the target, and it was confimed that there were no abnormal vibration and noise. Theoretical study were made on voltage fluctuations, resonance, etc., and it was confirmed that they were within the admittable range, presenting no problem. (4 figs)

21430 (NEDOJ—8702, pp 262-266) **Development of large-scale wind power generation system. Development of 100 kW class pilot plant.** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770076/JAW.

In FY 1986 NEDO annual report (Part 2).

For practical application of wind power generation, development of a large scale pilot plant and the demonstration test of the plant are made which contribute to the design and production of a large-scale wind power plant and grasping of the accompanied various problems. By this study, started in FY 1981, the construction of the 100 kW pilot plant in Miyake Island, operation test of the plant, and combination test of the plant with the power distribution systems, were made. In FY 1986, the pilot plant was cannibalized, followed by inspection of each part and the strength test of the blade. Significant degradations in the paint of the blade were found. Also, holes and grooves in the joint between the upper and the lower surface of the blade were found. The joint method should be improved. The nacelle was more or less rusted. No significant problems on the axes, the bearings, the couplings, and the lubricating oil were found. The bending test of the blade, and the strength test of the blade members gave good results. However, the adhesion of the CFRP to the blade surface, and the shape of the internal webs should be further examined. The results have revealed that the pilot plant has a sufficient durability. (1 fig, 3 tabs)

21431 (NEDOJ—8702, pp 267-273) **Development of MW class large scale wind power generation system. Wind survey.** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770076/JAW.

In FY 1986 NEDO annual report (Part 2).

For obtaining the design data on a large scale wind power system, the wind survey near the summit of Kuwatayama, Shirio-

zaki, Aomori Prefecture, which is supposed to be a proper field for wind power generation, was made. An iron tower of 4 m high was installed near the summit. The wind survey has been made since October, FY1983. In 1986, in addition to the survey made in the winter in FY1985, the field was surveyed for 92 days from August to November for collecting the wind data in the summer and autumn. A Doppler wind direction and velocity meter (XONDAR) was used for the survey at the height from the ground of 40 - 128 m, and an acrovane mounted to the iron tower used for the survey at the height of 10 - 40 m. The monthly-averaged wind velocity was 8.8 - 13.2 m/sec. at the height of 84 m, and was increased in the time of August to November. The advent ratio of the wind velocity within the range of 5 - 25 m/sec. was 83 - 86% based on the total survey period, which was lower than that in the winter. The energy supply for 92 days in the summer and autumn was 1709 kWh/m at the height of 84 m, which was about a half of that in the winter.(2 figs, 2 tabs)

21432 (NEDOJ—8702, pp 274-278) **Development of 1-10 MW class large scale wind power generation system. Development of element techniques.** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770076/JAW.

In FY 1986 NEDO annual report (Part 2).

For developing a large-scale wind power system, the acrodynamic and the resonance analyses, which are required for design of the essential parts of the plant such as a rotor, a blade, a tower, and the like, are made. Based on the results, element technique as to the structure of the elements and the manufacturing is developed. The FY1986 investigation results of the wind power system with the output set on 1 MW are as follows. For the rotor, employment of a tectered hub was examined. This system proved to be effective for reduction in the fluctuation width of a blade load, which enables a small-size and light-weight blade attachment and hub to be employed. The blade strength and rigidity, which is required under wind variation, was analyzed, giving a prospect of the production method. The material, anti-corrosion method, snow covering, etc. of the blade were examined. Further, the relationship between the monopole diameter and the resonance wind velocity was analyzed. For the equipments in the nacelle, a variable pitch control actuator was examined. The axial system including the blade and the hub was resonance analyzed.

20 ELECTRIC POWER ENGINEERING

REFER ALSO TO CITATION(S) 21349, 22241

21433 (NEDOJ—8702, pp 451-452) **Investigation for establishment of load collection control system.** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770076/JAW.

In FY 1986 NEDO annual report (Part 2).

For realization of power consumption levelling, a control system is investigated for the practical applications, by which system consumer loads are collected and controlled by a power company. The investigation is a three-year scheme of 1986 to 1988, in 1986, and outline and a demonstration-system for the control system were designed. In the outline design, electric water heaters and heat-storage type air conditioners exemplified as an apparatus to be load-collection controlled, were investigated or estimated on the way that these apparatus are paractically used, and the usefulness of the collection control system to these apparatus. Further, developments of the automation systems and concerned apparatus for consumers were investigated. For multi-purpose utilization of the collection-control system, i.e., for application of the system to control of dispersed power plants, automatic control of distribution switches, automatic energy detection and so forth, it has been revealed that emploment of a bilateral communication system using optical fibers or coaxial cables should be preferred. Based on the investigation results, an outline of the collection-operation system for a 320,000 consumers model-office was designed.

2001 Power Plants And Power Generation

REFER ALSO TO CITATION(S) 20879, 21206, 21217, 21528, 21529, 21530, 21531, 21532, 21681, 21683, 21684, 22352, 23213, 23214

21434 **(EPRI-AP—5467) Economics of phased gasification - combined-cycle plants: Generic system results: Final report.** (Electric Power Research Inst., Palo Alto, CA (USA); Zaininger Engineering Co., San Jose, CA (USA)). Feb 1988. 83p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920204/JAW.

This report contains production costing and fixed charge analyses of the phased installation of gasification combined-cycles. The economic merit of phased GCC's was evaluated both against a variety of hypothetical utility systems and in the context of a variety of fuel forecasts, capital charge assumptions and other input parameters. This report is intended to complement the utility-authored site- and system-specific report (No.AP-5466) on the same subject. 10 figs., 43 tabs.

21435 **(EPRI-AP—5611) Repowering options study: Final report.** Walters, A.B. (Florida Power and Light Co., Juno Beach (USA)). Jan 1988. 229p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920169/JAW.

Results of a scoping study in which natural-gas-fueled combustion turbines are utilized to repower existing oil-fired/gas-fired steam turbine generating units are presented. A representative range of unit sizes, 80 to 800 MW, was investigated. Depending on the unit and repowering configuration, repowering resulted in calculated heat rate reductions of 7% to 18% and calculated increased unit outputs of 28% to 165%. The estimated installed costs per kW of added new generating capacity ranged from $363/kW to $589/kW, again depending on the unit and repowering configuration. Design considerations for various repowering configurations are also presented. 23 figs., 21 tabs.

21436 **(EPRI-CS—5627) Fossil unit performance: 1965-1984: Final report.** Voegtle, R.B.; Koppe, R.H. (Stoller (S.M.) Corp., Boulder, CO (USA)). Feb 1988. 161p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920192/JAW.

This report presents the results of an analysis of the performance of fossil power plants sized 200 MW and larger during the period from 1965 through 1984. This study is based upon analysis of the information collected over the years by the Equipment Availability Task Force of the Prime Movers Committee of the Edison Electric Institute (EEI) and more recently by the North American Electric Reliability Council (NERC) and covers approximately 7700 unit-years of experience at 668 individual units. In addition to overall unit performance, the study covers the contribution to unit performance of major plant areas (boiler, turbine, etc.) and cause groups within these areas (waterwalls, turbine vibration, etc.). The relationship of this performance to major unit characteristics such as size, age, vintage, fuel burned, steam pressure (subcritical/supercritical), and furnace pressure (pressurized/balanced draft/converted to balanced draft), as well as calendar year variations in performance is presented and discussed. 41 figs., 4 tabs.

21437 **(EPRI-EL—3729-CCM-Vol.2) Optimization of reactive volt-ampere (VAR) sources in system planning: Volume 2, User's manual.** Lebow, W.M.; Nadira, R. (Scientific Systems, Inc., Cambridge, MA (USA)). Feb 1988. 162p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920216/JAW.

This volume contains the User's Guide for the VAROPT prototype computer program developed under EPRI-RP-2109-1 to optimize the location and sizes of new reactive sources in large-scale power systems with up to 1500 buses. This guide contains complete discussions of all aspects related to program installation and execution, as well as several examples and test cases. VAROPT is an implementation of the two-level approach for the optimization of reactive source allocation in power systems developed during the course of this project. This two-level approach takes advantage of the natural distinction between the var dispatch in system oper-

ation (Level 1) and the var allocation in system planning (Level 2). Level 1 is an optimal power flow problem formulated as a nonlinear programming problem and solved using a projected augmented Lagrangian technique. Level 1 can handle contingency constraints in either a corrective or in a preventive mode. Level 2 is an optimal reactive source expansion problem formulated as a mixed linear-integer programming problem and solved using a branch-and-bound technique. The two levels are related together using a very powerful and optimal decomposition technique known as the Generalized Benders Decomposition. Initial testing of the VAROPT package with real power systems of different sizes and characteristics have confirmed that the programs are a very valuable tool for reactive source allocation.

21438 **(EPRI-EL—4522-Vol.3) Advanced power system security analysis concepts: Volume 3, New security measures and multiple contingency selection methods: Final report.** Schlueter, R.A.; Sekerke, J.E.; Forgey, H.L.; Burnett, K.L.; Costi, A.G. (Michigan State Univ., East Lansing (USA). Div. of Engineering Research). Feb 1988. 223p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920209/JAW.

This volume presents the results of the third task of the project that includes: (a) the development of new contingency measures that separate critical and noncritical loss of contingencies and properly rank critical and noncritical contingencies; (b) development of new measures that can identify the monitored branches, paths and interfaces that are most severely affected by single and multiple contingencies; (c) the development of methods for selection and ranking severity of multiple contingencies; (d) a discussion of the application of this new security assessment methods in transmission reliability, transfer capability calculation, and posturing; and (e) use of this security assessment method in determining the monitored branches, paths and interfaces and the selection of single and multiple contingencies for a transfer capability study.

21439 **(EPRI-EL—5568) Distributed fiber-optics hot spot sensor: Final report.** Kingsley, S.A.; McGinniss, V.D. (Battelle Columbus Div., OH (USA)). Dec 1987. 56p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920149/JAW.

This report describes a new fiber-optic technique for detecting hotspots in electrical machinery, particularly in stator windings of large generators and in transformers. The technique employed is based on an optical radar approach and proprietary coating materials whose optical losses and/or refractive indices are a marked function of temperature. The technique may also be employed for the monitoring of transmission lines, since there are considerable economic factors involved with maintaining the maximum loading on a line without causing local overheating. The Distributed Fiber-Optic Sensing System (DFOSS) can be said to employ FODAR (Fiber Optic Detection and Ranging) techniques. Various materials have been identified that might be suitable for a distributed hot-spot sensor. The approach adopted here to obtain temperature-sensitivie optical fibers is to choose a special polymer material that can act like a core or cladding. In particular, coatings have been developed which are suitable as optical claddings for borosilicate types of fiber. These coatings change their optical properties, i.e., refractive index, scattering and absorption, as a function of temperature. 19 refs., 24 figs., 6 tabs.

21440 (EUR—10567, pp 647-675) **Materials requirements for advanced steam plant.** Scarlin, R.B.; Bertilsson, J.E.; Stiefel, W.; Walser, B. (BBC, Brown Boveri, Baden (Switzerland)). 1986. D. Reidel Publishing Company, Dordrecht, Netherlands. (CONF-861025—).

From 3. conference on high temperature alloys for gas turbines and other applications; Liege, Belgium (6 Oct 1986).

Current developments are aiming at the improvement of the efficiency of steam power plant. Efficiency increase results in a reduction in fuel consumption, a factor of growing importance. Considerable advantages will result from raising the live steam temperature from the current value of about 540 C to 600 C or higher and supercritical pressure operation. However experience at a power station operating under such advanced steam conditions (elevated temperature and pressure) has shown that material problems must be anticipated both in the turbine and the boiler. Since the requirements include high availability along with low capital costs and flexibility of operation it was clear that for advanced designs improved materials must be used. There is a particular requirement for components with: high creep strength, able to withstand operation at higher steam temperatures; improved resistance to low cycle fatigue, suitable for two shift and cycling operation; low tendency to oxidation and exfoliation at higher steam temperatures. The present paper identifies alternative approaches to these problems, highlighting the current position using results from extensive development programmes and stressing direction in which further work must be undertaken. 37 refs., 22 figs.

21441 (EUR—10567, pp 219-244) **High temperature alloy requirements for coal fired combined cycles.** Davidson, B.J.; Meadowcroft, D.B.; Stringer, J. (Central Electricity Generating Board, Leatherhead (Surrey). Central Electricity Research Laboratories). 1986. D. Reidel Publishing Company, Dordrecht, Netherlands. (CONF-861025—).

From 3. conference on high temperature alloys for gas turbines and other applications; Liege, Belgium (6 Oct 1986).

High temperature alloys are system-limiting in many ways in coal-fired combined cycles. The aim of this paper is to consider the thermodynamic and economic aspects of pressurized fluidized bed and gasification combined cycles which are affected by materials factors, in order to set into context the necessary high temperature alloy research. In pressurized fluidized bed systems the critical materials requirements are in the combustor, hot gas clean up system and gas turbine. In gasification combined cycles there is the specific requirement in many systems of the raw gas heat exchanger. It is also essential to have an advanced turbine with high (1250 C) turbine entry temperature, but as the gas can be cleaned as much as necessary no specific problems such as corrosion result. Indeed for both types of cycle the system limiting materials factors are corrosion and/or erosion rather than mechanical properties. Recent work and directions for further work are summarized for each critical plant area. In general, high temperature alloy solutions for each critical requirement can be proposed but not always without limiting the system efficiency or at a significant cost. 43 refs., 5 figs., 6 tabs.

21442 (NEDOJ—8401, pp 663-674) **Development of advanced type battery energy storage system.** Aug 1984. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770050/JAW.

In FY 1983 NEDO Annual Report.

Aiming to development of an electric energy storage system based on a large-capacity battery system and equipped with a load leveling function, investigation was conducted to develop sodium-sulphur, zinc-chlorine, and zinc-bromine battries and a system which can be run in combination with an actual power system. The target of the development is a power of 1000 kW, standard charging and discharging times of 8 hours each, a life span of about 10 years, a total energy efficiency of 70% or more. The results of the investigation are as follows: For each of the three types of battery, a 1 kW class prototype was elaborated and tested. Each prototype was evaluated for its charged and discharged electric energy, charging and discharging energy efficiency, self-discharge, and life. For system technology research and development, automatic control, data collection, and other component system were designed to develop 1 MW class lead batteries, and operation schemes were developed. The results of the life test conducted for a miniature battery were satisfactory because they showed 1830 cycles and 1620 cycles at the end of March, 1984. (5 figs, 2 tabs)

21443 **(NYSERDA—87-27) Characterization and utilization of fuel oil blends used by New York utilities: Final report, March 1, 1985-August 31, 1986.** Longanbach, J.R.; Steedman, W.G.; Mezey, E.J.; Anson, D. (Battelle Columbus Div., OH (USA)). Nov 1987. 210p. New York State Energy Research and Development Authority, Two Rockfeller Plaza, Albany, NY 12223. Order Number TI88900456/JAW.

This report presents a brief review of residual fuel oils used by the electric utilities of New York State. (JDH)

21444 (PB—88-157375/XAB) Field evaluation of gas reburning-sorbent injection technology. Topical report. Folsom, B.; Bartok, W.; Heap, M. (Energy and Environmental Research Corp., Irvine, CA (USA)). Jul 1987. 19p. NTIS, PC A03/MF A01.

This paper describes a field-evaluation project that will be funded cooperatively by GRI, the Department of Energy, and the State of Illinois Department of Energy and Natural Resources, to evaluate gas reburning-sorbent injection (GR-SI) on three coal-fired utility boilers located in Illinois. GR-SI will be applied to one each of wall-, corner-, and cyclone-fired boiler types with overall reduction targets of 60% in NOx and 50% in SO_2 emissions. This report presents an overview of the planned field-evaluation project, including design considerations and economic projections for GR-SI applications.

21445 Laser-enhanced electron attachment and its possible application for optical switching. Pinnaduwage, L.A.; Christophorou, L.G.; Hunter, S.R. pp 10-17 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

From 5. international symposium on gaseous dielectrics; Knoxville, TN, USA (3 May 1987).

Observation of enhanced electron attachment to electronically excited thiophenol (C_6H_5SH) and thioanisole ($C_6H_5SCH_3$) molecules produced by excimer laser irradiation is reported. The potential significance of this finding for high-power diffuse discharge opening switches is indicated. 9 references, 8 figures.

21446 Galvanooptical measurement of photodetachment from negative ion swarms in oxygen. Teich, T.H.; Morris, E.C.A. (Swiss Federal Institute of Technology, Zuerich). pp 18-26 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

From 5. international symposium on gaseous dielectrics; Knoxville, TN, USA (3 May 1987).

An optogalvanic method is described which permits assessment of the density of certain negative ions in dependence upon time and location. Ion swarms generated by way of pulsed UV laser irradiation of the cathode of a homogeneous field discharge gap are intercepted by another pulsed laser beam producing photodetachment and thus an electron current transient. Signal amplitude is a function of ion species, ion density, laser pulse energy density and interception geometry. Though measurements in oxygen ($n = 5, 10, 20 \times 10^{17}$ cm^{-3}, E/n = 110 Td) seem to support the model of initial O^- formation with subsequent conversion to O_2^-, the time constants found for the decay of the O^- population require further scrutiny as do the reaction rate coefficients in the literature. It is also experimentally confirmed that O^- ions formed in CO_2 are too short-lived to yield a substantial number of photodetached electrons upon ruby laser irradiation 10 ns after generation of the swarm of 10^9 negative ions. 22 references, 7 figures.

21447 Electron collision cross sections for C_2F_6 and N_2O. Hayashi, M.; Niwa, A. (Nagoya Institute of Technology, Japan). pp 27-33 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

From 5. international symposium on gaseous dielectrics; Knoxville, TN, USA (3 May 1987).

A set of electron collision cross sections for C_2F_6 and N_2O have been determined from electron beam and electron swarm data for electron energies from 0 to 10^3 eV. Electron swarm parameters for C_2F_6 - Ar and C_2F_6 - CH_4 mixtures have been calculated and these values almost coincide with experimental data measured at Oak Ridge National Laboratory. 36 references, 8 figures.

21448 Macroscopic model of electron swarm motion in non-equilibrium regions. Boeuf, J.P.; Davies, A.J.; Evans, J.G.; Marode, E.; Segur, P. (Universite Paul Sabatier, Toulouse, France). pp 34-39 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

From 5. international symposium on gaseous dielectrics; Knoxville, TN, USA (3 May 1987).

The macroscopic model of electron swarm motion in non-equilibrium region previously developed by the authors has been extended to take into account the additional ionization due to the beam-like group of fast electrons that have not undergone any inelastic collisions since their emission from the cathode. The extended model gives good agreement with corresponding Monte Carlo and Boltzmann calculations for helium for E/p in the range 50 to 150 V cm^{-1} Torr^{-1}. 6 references, 2 figures.

21449 Non-equilibrium description of electrons in a gas influenced by space-time varying electric fields. Kunhardt, E.E.; Wu, J.; Penetrante, B. (Polytechnic Univ., Farmingdale, NY). pp 40-46 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

From 5. international symposium on gaseous dielectrics; Knoxville, TN, USA (3 May 1987).

In this paper, a non-equilibrium description of the dynamics of electrons in a background gas under the influence of space-time varying fields is presented. It is obtained by interpolating between a kinetic and a moment formulation. Comparisons are presented between results obtained with this formulation and those obtained from a kinetic model. 10 references, 2 figures.

21450 Temperature dependent electron transport and rate coefficient studies for e-beam-sustained diffuse gas discharge switching. Carter, J.G.; Hunter, S.R.; Christophorou, L.G. pp 47-54 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

From 5. international symposium on gaseous dielectrics; Knoxville, TN, USA (3 May 1987).

Measurements of the electron drift velocity, w, attachment coefficient, eta/N/sub a/, and ionization coefficient, α/N, have been made in C_2F_6/Ar and C_2F_6/CH_4 gas mixtures at gas temperatures, T, of 300 and 500 K over the concentration range of 0.1 to 100% of the C_2F_6. These measurements are useful for modeling the expected behavior of repetitively operated electron-beam sustained diffuse gas discharge opening switches where gas temperatures within the switch are anticipated to rise several hundred degrees during switch operation. 13 references, 9 figures.

21451 Time dependent conductivity studies of electron thermalization in simple gases. Cooper, R.; Rodrigo, H.; Porter, I. (Univ. of Melbourne, Victoria, Australia). pp 55-60 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

From 5. international symposium on gaseous dielectrics; Knoxville, TN, USA (3 May 1987).

A pulse radiolysis study has been made using a 3ns pulsed electron beam source together with a microwave absorption technique (9 GHz) of the conductivity versus time in pulse irradiated gases. The relaxation of electron energy in helium, hydrogen, nitrogen, krypton and xenon has been probed by observing the conductivity variation with pressure and time. Simple behavior is observed in these systems except for those exhibiting Ramsauer minima where the system is complex. 10 references, 6 figures.

21452 Breakdown mechanisms in electronegative gases. Gallimberti, I. (Univ. of Padova, Italy). pp 61-80 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

From 5. international symposium on gaseous dielectrics; Knoxville, TN, USA (3 May 1987).

Extensive investigations into various phases of discharge development in electronegative gases (corona formation, streamer to leader transition, leader steps and reilluminations) are summarized in this paper. For each phase the most significant experimental results obtained in recent years are reported, in order to derive a detailed description of the relevant basic phenomena. The major differences between the discharge behavior in strongly-electronegative gases (SF_6) and weakly-electronegative gases (air) are discussed, and the transition between the two is analyzed in terms of discharge characteristic size and attachment length. Numerical simulations are reported that confirm the proposed interpretation of the

experimental results and reveal interesting details of the different discharge phases. 16 references, 15 figures.

21453 **Prediscarge development in N_2 and SF_6 at high gas pressure.** Lieberoth-Leden, B.; Pfeiffer, W. (Technische Hochschule Darmstadt, Germany, F.R.). pp 81-87 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

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The prediscarge development under DC conditions has been investigated in compressed N_2 (up to 6 bar) and SF_6 (up to 2.4 bar). The electrode configuration was a sphere-sphere gap with a distance of 10 mm and a nearly homogeneous field distribution (eta = 0.79). The maximum breakdown voltage was 200 kV. 8 references, 7 figures.

21454 **Effect of temperature on the uniform field breakdown strength of electronegative gases.** Christophorou, L.G.; Mathis, R.A.; Hunter, S.R.; Carter, J.G. pp 88-97 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

From 5. international symposium on gaseous dielectrics; Knoxville, TN, USA (3 May 1987).

In general, the electron attachment rate constant, k/sub a/ (<epsilon>, T), as a function of the mean electron energy <epsilon> and temperature T for electronegative gases which attach electrons nondissociatively decreases greatly with T from room temperature to T ≦ 600K, while that for electronegative gases which attach electrons dissociatively increases with increasing T. Based on recent studies in our laboratory on k/sub a/ (<epsilon>,T), the authors investigated the variation with T (~ 295-575K) of the uniform field breakdown strength, (E/N)/sub lim/ , for three classes of electronegative gases: (a) gases such as c-C_4F_8 (and c-C_4F_6) which attach strongly low-energy (≦ 1 ev) electrons nondissociatively and for which k/sub a/ (<epsilon>, T), decreases precipitously with T above ambient; (b) gases such as C_2F_6 and CF_3Cl which attach electrons exclusively dissociatively and whose k/sub a/ (<epsilon>, T) increases with T; and (c) gases such as C_3F_8 and n-C_4F_{10} which attach electrons both nondissociatively and dissociatively over a common low-energy range and whose k/sub a/ (<epsilon>, T) first decreases and then increases with T above ambient. The (E/N)/sub lim/(T) has been found to decrease significantly with T for (a), to decrease slowly with T for (c), and to increase slightly with T for (b). These changes in (E/N)/sub lim/ follow those in k/sub a/ (<epsilon>, T). A similar behavior is expected for other electronegative gaseous dielectrics in the respective three groups. 17 references, 10 figures, 1 table.

21455 **Influence of thermal ionization on electrical breakdown.** Howatson, A.M. (Univ. of Oxford, England). pp 98-103 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

From 5. international symposium on gaseous dielectrics; Knoxville, TN, USA (3 May 1987).

A model for electrical breakdown is presented in which terms representing thermal ionization and volume recombination are included in the usual equations which govern the flow of current due to electron multiplication. In this way the effect of elevated gas temperatures, around 4000 K, on gas breakdown can be calculated, and the transition between dielectric and thermal breakdown investigated. Curves are presented for nitrogen. 5 references, 2 figures.

21456 **Contribution to a unified theory of the leader processes.** Kekez, M.M. (National Research Council of Canada, Ottawa). pp 104-117 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

From 5. international symposium on gaseous dielectrics; Knoxville, TN, USA (3 May 1987).

The authors have carried out a number of experimental, analytical and numerical studies on corona development and corona-arc transition as well as leader motion in both initial and final jump phase. A search of the relevant experimental literature suggests that nearly all the observations can be explained by either of two hydrodynamic models. These are the hypersonic detonation and hypersonic flame model. Good agreement with experimental evidence extends over a wide range of current and spacing distances (0.09 - 2000A and 0.01 - 1750 m respectively). A new simplified derivation for the hypersonic flame model is given. This derivation considers the self-similar properties for the minimum sparkover voltage in air of a rod-plane (0.1 - 30 m) gap in both polarities. It is hoped that this work will yield practical operating criteria of use to the electrical engineer in the field. 24 references, 3 figures, 2 table.

21457 **Mechanism of a short gap breakdown.** Novak, J.P.; Bartnikas, R. (Institute de Recherche d'Hydro-Quebec, Varennes). pp 118-125 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

From 5. international symposium on gaseous dielectrics; Knoxville, TN, USA (3 May 1987).

A two-dimensional model of the breakdown development between plane-parallel electrodes was formulated, consisting of conservation equations for electrons, positive ions and excited particles and the Poisson equation. The model was solved numerically, using He as a test gas for a 0.48 mm gap between conductive electrodes with an applied voltage of 480 V. The development of the breakdown channel was followed from the moment of the release of the initial cloud of electrons for approximately 1 μs, at which time the electron, ion and excited particle densities attain maximum values of 10^{10}, 2 x 10^{11} and 2 x 10^{12} cm^{-3}. Examination of ionization processes has shown that contribution of Penning ionization is significant, while stepwise ionization remains small (relative density of the impurities was assumed to be 10^{-4}). Enhancement of the field in the cathode region at t = 1.1 μs is about 2 kV, while the maximum decrease near the anode is about 3 kV. Constriction of the channel and rapid increase of the growth rates of the charged particle densities indicate the occurrence of a spark-type breakdown. 19 references, 7 figures.

21458 **Experimental investigation of the streamer to leader transition in SF_6 under negative polarity.** Gallimberti, I.; Ullrich, L.; Wiegart, N. (Univ. of Padova, Italy). pp 126-133 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

From 5. international symposium on gaseous dielectrics; Knoxville, TN, USA (3 May 1987).

In this experiment, the discharge development in SF_6 under inhomogeneous field conditions and negative polarity is investigated using fast electrical and optical measurement techniques. Negative streamers have gross properties very similar to that of the well-understood positive ones. The streamer to leader transition is associated with the phenomenon of a leader precursor in both polarities, with remarkable differences in the details of the precursor structure and the behavior in SF_6 with small admixtures of some other gases. An interpretation is given based on numerical simulations. 7 references, 8 figures.

21459 **Modeling of leader branching in electronegative gases.** Niemeyer, L.; Wiesmann, H.J. (Brown Boveri Research Center, Baden, Switzerland). pp 134-139 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

From 5. international symposium on gaseous dielectrics; Knoxville, TN, USA (3 May 1987).

Based on the recently improved understanding of stepped leader propagation in electronegative gases a method for simulating branched leader patterns is presented. The results of the model are compared to experimental data and the influence of the electrode configuration on the leader pattern shape is discussed. 6 references, 3 figures.

21460 **Leader inception characteristics in positive sphere-plane air gaps.** Youwei, L.; Naixiang, M. (Xi'an Jiaotong Univ., China). pp 140-145 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

From 5. international symposium on gaseous dielectrics; Knoxville, TN, USA (3 May 1987).

The leader inception characteristics in sphere-plane air gaps subjected to (250/2500 μs) positive impulse voltages are studied. The results show that the leader initiated by first corona is random, and the inception probability (P/sub L/) increases with the increment of radii of HV sphere electrodes and is influenced by the rise rate of impulse voltages. There is a transition region between P/sub L/ = 0% and P/sub L/ = 100%. 8 references, 6 figures, 3 tables.

21461 **Velocity measurements in mixtures of SF_6 and N_2 in non-uniform field gaps under positive impulse voltage.** Rodrigo, H. (Univ. of Melbourne, Victoria, Australia). pp 146-151 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

From 5. international symposium on gaseous dielectrics; Knoxville, TN, USA (3 May 1987).

Velocity measurements of streamer and leader propagation have been carried out in a point plane gap geometry, in the pressure range 1 to 3 bar, when the gap was subjected to a positive impulse voltage of wave shape 1/50μs. A dual photomultiplier system together with a quartz lens and beam splitter was used in the measurements. The signals from the photomultipliers were displayed on a fast storage oscilloscope. The development of the spark from corona initiation to breakdown of the gap can be followed using these measurements. 7 references, 8 figures.

21462 **Decomposition of SF_6 by arc discharge and the determination of the reaction product S_2F_{10}.** Janssen, F.J.J.G. (Institutions of the Dutch Electricity Utilities, Arnhem, Netherlands). pp 153-162 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

From 5. international symposium on gaseous dielectrics; Knoxville, TN, USA (3 May 1987).

The use of sulfur hexafluoride as a dielectric medium in for example rail systems and gas circuit breakers, has led to concern about its decomposition products, which are to be expected in using such equipment. These products may be formed in arcs and are poisonous. High resolution and highly sensitive analytical methods are required for the determinations of trace amounts of sulfur fluoride compounds, present in arced sulfur hexafluoride. The main aim of the project was to study analytical techniques in order to determine these traces. The work was focused on the determination of traces of S_2F_{10} in SF_6 gas. Three types of detection are compared for determining these extremely low concentrations of S_2F_{10}. The methods are: (i) a gas chromatograph with flame photometric detection, (ii) a gas chromatograph coupled on a mass spectrometer, and (iii) a gas chromatograph equipped with an electron capture detector. One of the methods (iii), which will be described in this paper, allows the determination of extremely low concentrations of S_2F_{10} in arced SF_6 samples by means of on-column cryo-trapping followed by capillary gas chromatography and electron capture detection. 9 references, 5 figures, 2 tables.

21463 **Corona-induced decomposition of dielectric gases.** Van Brunt, R.J.; Herron, J.T.; Fenimore, C. (National Bureau of Standards, Gaithersburg, MD). pp 163-173 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

From 5. international symposium on gaseous dielectrics; Knoxville, TN, USA (3 May 1987).

A three-zone model for chemical decomposition of electronegative gases in negative point-plane corona discharges is proposed which considers the discharge glow, ion-drift, and main gas volumes respectively as separate regions of diminishing chemical activity and increasing relative size. The proposed model is shown to be useful in predicting discharge by-product yields and the dependences of these yields on discharge current and gas mixture composition. As an example, the model is applied here to the decomposition of pressurized SF_6 containing trace levels of water vapor and is shown to yield results for oxyfluoride production that are in satisfactory agreement with observations. 17 references, 2 figures, 1 table.

21464 **Degradation of the dielectric properties of SF_6 due to the presence of gaseous impurities; deviations to the Paschen's law at high pressures for positive polarity.** Berger, G.; Senouci, B.; Belabed, O.; Hutzler, B.; Riquel, G. (Laboratoire de Physique des Decharges, Gif-Sur-Yvette, France). pp 182-190 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

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The sparkover characteristics of SF_6, breakdown voltage as a function of pressure, is known to deviate from the Paschen's law at high pressure. Although this has been noticed a long while ago, its explanation remains doubtful. Generally these deviations are ascribed to the electrode roughness (local field amplification due to protusions). However, the actual protrusions are much smaller than those quoted to agree with the experimental breakdown voltage reduction. Experiments carried out for positive polarity in quasi-uniform field have shown that the breakdown voltage varies linearly with pressure for pure SF_6, even if the electrodes have been damaged by many previous sparks. Moreover, this experimental curve lies significantly above the theoretical curve derived from usual criteria. Deviations from linearity at high pressures are induced by additional impurities such as water vapor and/or oxygen, even for concentrations consistent with those found in industrial systems. 9 references, 7 figures, 1 table.

21465 **Influence of impurities on the dielectric strength of SF_6 for positive polarity; the nature of initiatory electrons.** Berger, G.; Senouci, B.; Hutzler, B.; Riquel, G. (Laboratoire de Physique des Decharges, Gif-sur-Yvette, France). pp 191-198 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

From 5. international symposium on gaseous dielectrics; Knoxville, TN, USA (3 May 1987).

Two kinds of sources of seed electrons are analyzed through the time lag distributions, namely the collisional detachment from negative ions preexisting in the gap and from negative ions formed by attachment of an electron released from the cathode and drifting towards the critical volume. In both cases, the role of impurities, especially water vapor and oxygen, are emphasized. The application of a bias voltage shows that the second mechanism is a mixed effect of adsorbed and adsorbed water vapor molecules on the cathode surface. 9 references, 6 figures, 2 table.

21466 **Formation and stability of SF_5 and S_2F_{10}.** Herron, J.T.; Tsang, W. (National Bureau of Standards, Gaithersburg, MD). pp 199-204 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

From 5. international symposium on gaseous dielectrics; Knoxville, TN, USA (3 May 1987).

The simulation of the dielectric breakdown of SF_6 through the use of computer modeling offers many advantages over more costly direct testing methods for determining the conditions under which potentially toxic by-products may be generated. A complete model calculation requires a knowledge of the rate constants or cross sections for all relevant processes. A complete data base of the nature has not yet been assembled. However enough data exist to begin to answer some of the pressing questions regarding the formation and stability of various proposed reaction intermediates. Computer modeling studies have been carried out for very simple systems in order to determine the conditions under which S_2F_{10} is formed and the role of water vapor in that process. Many other recombination products of undetermined toxicity such as S_2F_4, S_2F_6, and S_2F_8 can be formed following the breakdown of SF_6. The thermal stability of SF_5 and S_2F_{10} is discussed and the lifetimes of these species given as a function of temperature. 5 references, 2 figures, 4 tables.

21467 **SOF_4 production in spark breakdown of SF_6/O_2 mixtures.** Sauers, I. pp 205-212 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

From 5. international symposium on gaseous dielectrics; Knoxville, TN, USA (3 May 1987).

Data are reported on the production of thionyl-tetrafluoride (SOF_4) after spark discharges in SF_6/O_2 mixtures for added oxygen contents of 0, 1, 2, 5, 10, and 20%. All measurements were made for fixed total pressure, P = 133 kPa (1000 Torr) and for spark energy of 8.7 J per spark. The SOF_4 by-product increases with increasing O_2 content and becomes the most abundant oxyfluoride decomposition product when (O_2) > 11%. The net yields for SOF_4 formation range from 0.18 x 10^{-9} mol x J^{-1} at 1% O_2 content to 10.45 x 10^{-9} mol x J^{-1} at 20% O_2 content. The mechanism for SOF_4 production appears to involve the reaction of SF_4, an important initial product of SF_6 discharges, with atomic oxygen. A simple model which includes a fluorine depletion reaction resulting from oxygen content. Comparison of the SOF_4 spark yield with other discharges (arc and corona) is also made. 15 references, 4 figures, 3 tables.

21468 **Gas analysis as a diagnostic tool for gas-insulated equipment.** Chu, F.Y. (Ontario Hydro Research Division, Toronto). pp 219-227 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

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Gas analysis is a powerful tool in diagnosing the internal condition of gas insulated equipment. Many utilities have already used gas analysis techniques in their gas insulated switchgear (GIS) maintenance programs. The major incentive for using gas analysis as a diagnostic tool is that the technique itself is non-invasive and requires no retrofitting of complex equipment to the GIS. This paper reviews the basic requirements for a successful gas analysis program, with particular emphasis on measurement and interpretation techniques. Typical operating environments in SF_6 insulated switchgear and gas insulated transmission lines are described. Results of qualitative determination of decomposition products and their formation rates for various modes of electrical discharge are presented. Analytical techniques for laboratory and field applications are described. In detecting symptoms of equipment aging from electrical stresses, the fundamental decomposition mechanisms of SF_6 as a result of low energy electron and SF_6 interaction are discussed, as are the requirements for improved diagnostic techniques to detect these low level decomposition products. 16 references, 4 figures, 2 tables.

21469 **Possibility of diagnostics of GCB and GIS by gas chromatography.** Latour-Slowikowska, H.; Jankowicz, S.; Piechocki, A.; Lampe, J.; Slowikowski, J. (Electrotechnical Research Institute, Warsaw, Poland). pp 228-234 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

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The gas composition analysis of SF_6 by-products as a diagnostic method for the surveillance of GCB and GIS operation is considered. The contents of CF_4, SOF_4, SOF_2, SO_2 and SiF_4 are taken into account as a source of information on the anomalous service conditions. Measurement of the air and moisture content by the chromatographic method is also applied. The correlation between gaseous by-products, surface resistivity of spacers and solid by-products is considered, as well as the possibility to use some information furnished on the nature of reaction between SF_6 decomposition compounds and solid materials. 6 references, 2 tables.

21470 **Electrostatics of probe measurements of surface charge densities.** Pedersen, A. (Technical Univ. of Denmark, Lyngby). pp 235-241 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

From 5. international symposium on gaseous dielectrics; Knoxville, TN, USA (3 May 1987).

A relation between the induced charge on the sensor plate of a probe and the charge distribution residing on the surface of a dielectric is derived. Emphasis is given to the effects on the probe measurements brought about by permittivity, the relative dimensions of the sensor plate and guard ring, and the distance between the probe and the interface. 9 references, 3 figures.

21471 **Measurement of accumulated charge on dielectric surfaces with an electrostatic probe.** Yashima, M.; Fujinami, H.; Takuma, T. (Central Research Institute of Electric Power Industry, Tokyo, Japan). pp 242-248 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

From 5. international symposium on gaseous dielectrics; Knoxville, TN, USA (3 May 1987).

This paper discusses the measurement method of the accumulated charge (density σ) on the surface of solid dielectrics (specimens) such as DCGIS (dc gas insulated system) spacers. The relation between σ and the probe response has been discussed for various arrangements with uniform or nonuniform charge distributions. The charge in the surrounding area has a very large effect on the probe response especially for thick specimens. True surface charge distribution can be obtained by the multi-point measurement method with the aid of a numerical field calculation. The effectiveness of the method has been demonstrated experimentally for a model specimen. 9 references, 8 figures.

21472 **Effect of humidity on space charge growth in short air gaps.** Davies, A.J.; Dutton, J.; Turri, R.; Waters, R.T. (Univ. College of Swansea, England). pp 249-254 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

From 5. international symposium on gaseous dielectrics; Knoxville, TN, USA (3 May 1987).

Simultaneous measurements have been made of voltage, injected charge and electric field for a sphere-plane gap subjected to 100/2500 μs positive switching impulses for pressures in the range 0.5 to 1.4 bar and absolute humidities from 2 to 15 g m^{-3}. A detailed study has been made of the effect of humidity on the different phases of the discharge and, in particular, on the inception times, the time to breakdown and the magnitude of the charge injected during the primary and secondary corona. In addition, a newly designed field/charge probe has been used to study the interaction of the positive corona filaments with the cathode. 9 references, 5 figures.

21473 **Laser probing of air gaps under ac conditions.** Zaghloul, A.R.M.; Zahab, E.A.; Elshazly-Zaghloul, M. (Cairo Univ., Egypt). pp 255-261 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

From 5. international symposium on gaseous dielectrics; Knoxville, TN, USA (3 May 1987).

The authors introduce a novel method to probe an air gap under ac conditions. A laser beam is passed through the gap and amplitude and phase changes of the electric vector of the laser beam is measured by ellipsometry. The measuring circuit is completely independent of the high voltage energizing circuit. Expressions to obtain the dielectric constant of the gas within the gap are presented. Experimental results on two gap geometries at different gap lengths are presented. Temporal development of the gap is continuously monitored and obtained results are given. The reported measurements are highly accurate. Discussion of the results provides a brief explanation of the gap changes at different energizing high voltages. 1 reference, 4 figures, 3 tables.

21474 **Predicting the breakdown strength of mixtures from basic data.** Tagashira, H. (Hokkaido Univ., Sapporo, Japan). pp 263-271 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

From 5. international symposium on gaseous dielectrics; Knoxville, TN, USA (3 May 1987).

Studies related to prediction of breakdown strength for gas mixtures from basic data are introduced and discussed mainly in terms of the hierarchy of approximations as employed in recent publications. 15 references, 10 figures.

21475 Dielectric strength of dichlorotetrafluoroethane ($1,2\text{-}C_2Cl_2F_4$) determined in a combined swarm/breakdown study. Aschwanden, T.; Schmid, R. (Swiss Federal Institute of Technology, Zurich). pp 272-280 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

From 5. international symposium on gaseous dielectrics; Knoxville, TN, USA (3 May 1987).

The inherent dielectric strength of 1,2-dichlorotetrafluoroethane has been determined by measurements of the effective ionization coefficient using a pulsed swarm technique. Additionally, a systematic breakdown study has been carried out under well controlled uniform-field conditions to investigate the electrical breakdown strength of this gas at high products (Nd), N being the real gas number density and d the electrode separation. The values for the limiting breakdown field strength to gas density ratio, (E/sub b//N)/sub lim/, are decreasing when the gas density N increases. This effect is in agreement with results obtained from the swarm experiment, where the density-normalized effective ionization coefficient is not only dependent on E/N, but also on N. 17 references, 3 figures, 3 tables.

21476 Influence of gaseous admixtures to SF_6 on the corona stabilized regime at ac and at positive impulse voltage. Koenig, D.; Lautenschlaeger, H. (Technical Univ. Darmstadt, Germany, F.R.). pp 281-288 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

From 5. international symposium on gaseous dielectrics; Knoxville, TN, USA (3 May 1987).

The influence of different gaseous admixtures to SF_6 was investigated with respect to the corona stabilized regime. At AC-voltages three groups of gaseous admixtures could be identified demonstrating either an increased or a decreased corona stabilization or neutrality. Supplementary studies of the dielectric strength at positive lightning impulses were performed at selected admixtures. 7 references, 7 figures, 2 tables.

21477 Nonuniform field corona and breakdown characteristics of SF_6/freon mixtures. Ijumba, N.M.; Chalmers, I.D.; Farish, O. (Univ. of Strathclyde, Glasgow, England). pp 289-297 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

From 5. international symposium on gaseous dielectrics; Knoxville, TN, USA (3 May 1987).

The effect of the addition to SF_6 of small quantities of Freon 113 (up to 10% by partial pressure) on the dc corona discharge in a point/plane gap has been studied. It has been shown that the Freon not only increases the corona inception level and reduces the average corona current, but also affects the transient form of the current. Based on the results obtained, some tentative explanations are presented to explain previously observed improvements in the impulse strength of SF_6 with Freon addition. 9 references, 4 figures.

21478 Effect of a trichlorotrifluoroethane vapor additive on dielectric strength of SF_6 gas. Qiu, Y.; Sun, A.; Kuffel, E. (Xi'an Jiaotong Univ., China). pp 298-303 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

From 5. international symposium on gaseous dielectrics; Knoxville, TN, USA (3 May 1987).

The effect of a trichlorotrifluoroethane ($C_2Cl_3F_3$) vapor additive on surface discharges in SF_6 gas is reported as a continuation of our previous work which showed that a small amount of $C_2Cl_3F_3$ vapor could effectively increase both breakdown and corona inception voltages of SF_6 gas in a highly non-uniform field gap. Two different field configurations were adopted in the present work: one with predominantly tangential field lines and the other possessing very strong field components perpendicular to the gas/solid interface. At least 10% increase in both corona inception and flashover voltages was found when 1% $C_2Cl_3F_3$ vapor was added to SF_6 gas. 13 references, 4 figures.

21479 Measurement of the figure of merit M for several perfluorocarbon gases. Berril, J.; Christensen, J.M.; McAllister, I.W. (Technical Univ. of Denmark, Lyngby). pp 304-310 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

From 5. international symposium on gaseous dielectrics; Knoxville, TN, USA (3 May 1987).

High precision measurements of the linear part of the Paschen curve are reported for CF_4, C_2F_6, C_3F_8, C_3F_8, $n\text{-}C_4F_{10}$ and $c\text{-}C_4F_8$. From these measurements values for the pressure-reduced limiting electric field strength (E/p)/sub lim/ and the figure of merit M are derived. These two parameters can be used to characterize the insulating properties of a strongly electronegative gas. With the exception of $c\text{-}C_4F_8$, the results support the general trend in the M, (E/p)/sub lim/ functional relationship reported previously, and the existence of a lower limit to the range of validity is suggested. For $c\text{-}C_4F_8$, the value of M is ten times greater than would be expected from the associated (E/p)/sub lim/. 27 references, 1 figure, 8 tables.

21480 Breakdown voltage measurement of some vapor-mist dielectrics. Tagashira, H.; Miyamoto, Y.; Kaneko, Y.; Shimozuma, M.; Sato, T. (Hokkaido Univ., Sapporo, Japan). pp 311-316 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

From 5. international symposium on gaseous dielectrics; Knoxville, TN, USA (3 May 1987).

Experimental measurement reveals that the breakdown voltage of a gap in a buffer gas generally increases with addition of vapor-mist of dielectric liquids, thus confirming usefulness of the concept of vapor-mist dielectrics. The effect of raising the breakdown voltage by liquid vapor, thin liquid films on the electrodes, and liquid mist is separated. This demonstrates that the existence of mist really serves to increase the breakdown voltage. It is shown that some vapor-mist dielectrics can sustain high dielectric strength for more than forty minutes after mist generation is ceased and that generation of vapor-mist dielectrics can suppress already existing discharges. A possible explanation for raising the breakdown voltage by the mist is given. 4 references, 5 figures, 1 table.

21481 Gaseous media for plasma chemistry and etching. Flamm, D.L. (AT & T Bell Labs., Murray Hill, NJ). pp 317-325 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

From 5. international symposium on gaseous dielectrics; Knoxville, TN, USA (3 May 1987).

Radiofrequency discharge processing permits etching and deposition in the presence of thermally sensitive materials and directional patterning, which are essential for the fabrication of fine line microelectronics. Mixtures of halogens, halocarbons, inorganic halogen compounds and noble gases have been the most common components of feed gases for etching silicon and III-V compounds, while oxygen-containing feeds are used to strip or pattern organic materials. Plasma etching mechanisms can be characterized as physical sputtering, chemical etching, ion damage induced etching, and inhibitor ion assisted etching. The governing interactions are determined equally by the gaseous feed mixture and discharge and thermochemical variables. Relationships connecting etching characteristics to physical and chemical variables are reviewed. 5 references, 2 figures, 1 table.

21482 Practical implications of dry plasma processing. Mastroianni, M.J. (VacTenn, Inc., Santa Clara, CA). pp 326-333 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

From 5. international symposium on gaseous dielectrics; Knoxville, TN, USA (3 May 1987).

Gas plasma technology has emerged as a useful manufacturing tool in both the semiconductor and industrial surface treatment markets. The semiconductor plasma etch capital equipment market is approximately 100 million dollars per year and has enjoyed an annual growth rate of 10%. The industrial surface treatment market

is presently only 5-10 million dollars per year but has provided a radically new method for secondary treatment of plastics and rubber.

21483 Important considerations for optimizing production rates in RF discharge chemistry. Kushner, M.J.; Garscadden, A. (Univ. of Illinois, Champaign). pp 334-342 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

From 5. international symposium on gaseous dielectrics; Knoxville, TN, USA (3 May 1987).

Important issues which should be considered when optimizing RF discharges for use in plasma processing are discussed using results from electron kinetics and plasma chemistry models.Mixtures of Ar/SiH_4 and H_2/SiH_4 are discussed as exemplary systems for the plasma deposition of amorphous silicon. The effect of dissociation of the feed stock gas on subsequent rates of dissociation is discussed, as is the effect of diluting silane discharges with argon. 9 references, 6 figures.

21484 Negative dc corona discharge in SF_6 for highly divergent fields. Frechette, M.F.; Mitchel, G.R.; Parpal, J.L. (Institut de Recherche d'Hydro, Varennes, Quebec). pp 343-350 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

From 5. international symposium on gaseous dielectrics; Knoxville, TN, USA (3 May 1987).

Negative discharge properties in SF_6 have been investigated for highly divergent fields. A point-to-plane geometry was used, the hemispherical tip of the rod being 1 mm in diameter and the gap lengths, typically smaller than 20 mm. Current-voltage characteristics, current-pulse activity and light emission of the discharge were studied in the corona-stabilized regime. At low pressures (e.g. 13.3 kPa) and shorter gaps ($\sim$ 10 mm), the square root of the current is found to vary linearly with the voltage while at higher pressure (say 300 kPa), the Townsend relation seems to be more representative. Current-pulse activity shows distinguishing features with the variation of the gap length and corona voltage, especially between assumed regions of unipolar drift and above the estimated saturation-current limit. Some image converter recordings were taken at breakdown for low and high pressures and short gaps ($<$ 5 mm). While breakdown was observed to occur via streamer mechanisms, luminous-event structures are found to differ depending on external parameters. 9 references, 6 figures.

21485 Calculation of corona onset voltage with space charge effect. Kim, E.S.; Lee, K.C.; Park, J.K. (Seoul National Univ., Korea). pp 351-355 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

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This paper presents an improved method for calculating corona onset voltage (COV) in a positive point nonuniform electric field air gap. Three criteria are largely used for the determination of corona onset: the first one is based on the photoionization process, the second one is based on the number of positive ions, and the third one is suggested by Khaled. During corona discharge, space charge is generated, and in turn it affects the electric field. In this paper, based on the second criterion, the authors attempt to improve the conventional COV calculation methods. With conventional methods, the calculations are finished when the boundary of the avalanche reache the electrode tip; this causes the space charge to have less effect on the boundary condition of the electrode. The authors method requires electron avalanche to advance further to the electrode for the corona onset, thereby creating a noticeable effect on the boundary condition by space charge. The authors also offer a more complex space charge model. Charge simulation method is used in calculating the electric field distribution. The calculated value by our method is closer to the experimental value than that by Parekh's and the space charge fields effect by our method is greater than the by Parekh's. 8 references, 3 figures, 2 tables.

21486 DC corona control in coaxial gas insulating systems. Waters, R.T.; Davies, A.E.; Boudjelthia, H. pp 356-361 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

From 5. international symposium on gaseous dielectrics; Knoxville, TN, USA (3 May 1987).

A method is presented of improving the dc corona performance of gas insulating systems using a resistive barrier arrangement fixed to the H.V. conductor. Effects of barrier material and geometry on the electric field and corona current characteristics of the system are given. The charging of these barriers in the region of the conductor is found to lead to a major redistribution of electric field and to raise the corona and sparkover voltage. 7 references, 5 figures, 1 table.

21487 Gas engineering for pulsed power and switching. Hunter, S.R. pp 363-373 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

From 5. international symposium on gaseous dielectrics; Knoxville, TN, USA (3 May 1987).

Studies of externally sustained diffuse gas discharge switches have demonstrated that diffuse discharges possess the potential for fast, repetitive, high power switching in inductive energy storage pulsed power applications. Several analyses have determined the operating requirements on the diffuse discharge in these applications and have shown the importance of gas engineering by tailoring the properties of the gas mixture within the switch to achieve the desired operating conditions. More recently, attention has been turned to ways of improving the current switching efficiency of these discharges (i.e., lower discharge impedance operation) and to the development of techniques to actively control the switch opening and closing by optically modifying the electron attachment and detachment processes in the discharge gas mixture. These and other possible research areas in gas engineering studies for pulsed power switches are discussed. 32 references, 9 figures.

21488 Penning ionization ternary gas mixtures for diffuse discharge opening switches. Schaefer, G.; Schoenbach, K.H.; Korzekwa, R.A.; Kristiansen, M. (Polytechnic Univ., Farmingdale, NY). pp 374-380 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

From 5. international symposium on gaseous dielectrics; Knoxville, TN, USA (3 May 1987).

Electron beam controlled diffuse discharges are promising candidates for high power opening switches in inductive energy storage circuits. In order to achieve short opening times when the electron beam is turned off, the switch gas mixture must contain an attacher. Ternary gas mixtures using a Penning additive in a mixture consisting of a buffer gas and an electron attacher can increase the switch efficiency through optimization of the ionization efficiency of the electron beam. The Penning additive, however, also decreases the breakdown voltage of the gas mixture. This paper presents experiments demonstrating these effects. 8 references, 3 figures.

21489 Gas mixtures for spark gap closing switches with emphasis on efficiency of operation. Christophorou, L.G.; McCorkle, D.L.; Hunter, S.R. pp 381-388 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

From 5. international symposium on gaseous dielectrics; Knoxville, TN, USA (3 May 1987).

The efficient operation of a spark gas closing switch requires a gaseous medium with large breakdown strength, low conduction voltage, and a short formative time lag. Gas properties necessary to achieve these requirements are identified and discussed. Based on available knowledge of such properties, a number of binary (e.g., c-C_4F_8, or 1-C_3F_6, or n-C_4F_{10}, or C_3F_8, or C_6F_6 in Ar or He or H_2) and ternary gas mixtures (e.g., c-C_4F_8, or n-C_4F_{10}, or C_3F_8 in Ar or He + C_2H_2 or another low ionization onset additive) have been identified which may be suitable for use in spark gap closing switches. 13 references, 6 figures, 2 tables.

21490 Influence of transverse magnetic fields on glow discharges in He/SF_6 gas mixtures. Schoenbach, K.H.; Powers, T.; Cooper, J.R.; Schaefer, G. (Old Dominion Univ., Norfolk, VA). pp 389-397 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

From 5. international symposium on gaseous dielectrics; Knoxville, TN, USA (3 May 1987).

The application of a magnetic field transverse to the electric field in an ionized gas causes a shift in the electron energy distribution towards lower energies. This shift affects the transport and rate coefficients, and consequently the resistivity of the ionized gas. This effect could be utilized to modify the resistance of glow discharges and to use them for high power switching. In order to model the positive column of glow discharges in He/SF_6 gas mixtures, Monte-Carlo codes were used to determine the rate and transport coefficients. With the obtained values the current density - electric field characteristics of the positive column were computed. Besides steady state characteristics, the transient dynamic response of the discharge due to changes of the transverse magnetic field was studied. To investigate glow discharges in magnetic fields experimentally, a coaxial discharge system was used which allows application of axial magnetic fields up to 1.2 Tesla. Measurements of the discharge voltage and current in a 80% He/20% SF_6 mixture at a pressure of 8 torr were performed at varying magnetic field intensities. The discharge voltage was found to increase with increasing magnetic field as predicted by our model. 6 references, 7 figures.

21491 Analysis of the cathode fall of glow discharges in a He/SF_6 gas mixture. Ko, S.T.; Schoenbach, K.H.; Lakdawala, V.K.; Chen, H. (Old Dominion Univ., Norfolk, VA). pp 398-403 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

From 5. international symposium on gaseous dielectrics; Knoxville, TN, USA (3 May 1987).

A Monte-Carlo code was used to calculate the electron energy distributions and the transport and rate coefficients in the cathode fall region of glow discharges in a He/SF_6 gas mixture. The charge carrier densities and the current densities were computed by means of a continuum model. Through an iterative procedure a self consistent solution for the cathode fall was approached. In order to study the influence of externally applied magnetic fields on the cathode fall, the calculations were repeated for a transverse magnetic field of 0.5 Tesla. 17 references, 6 figures.

21492 Gas engineering studies for high pressure self-sustained diffuse discharge closing switches. Hunter, S.R.; Christophorou, L.G.; Carter, J.G. pp 404-411 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

From 5. international symposium on gaseous dielectrics; Knoxville, TN, USA (3 May 1987).

The operating voltage and discharge stability of diffuse discharges for fast-closing switch applications are critically dependent on the variation of the ionization (α/N) and attachment (eta/N) coefficients with E/N (gas density normalized electric field strength). Gases and gas mixtures which possess low (E/N)/sub lim/ values (i.e., the E/N value when anti α/N = α/N = eta/N = O) and effective ionization coefficients, anti α/N, which vary slowly with E/N near (E/N)/sub lim/ lead to lower voltage (i.e., more efficient) operation with increased discharge stability. Several gas mixtures with these characteristics are discussed. It is argued that further improvements in switch efficiency and discharge stability can be obtained by adding a low ionization onset gas additive to these binary mixtures, such that at low E/N, α/N > eta/N, while at higher E/N, eta/N > α/N over a restricted E/N range. Several low ionization onset gas additives are suggested in this paper and the electron attachment and ionization coefficients in selected gas mixtures which posses these desirable characteristics are given. 11 references, 5 figures, 2 tables.

21493 Diffuse discharges in high-pressure mixtures of c-C_4F_8 and He. Byszewski, W.W.; Veale, J. (GTE Labs. Inc., Waltham, MA). pp 412-418 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

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Transient discharges in mixtures of c-C_4F_8 (0.5% to 7%) and helium were experimentally investigated in a high-voltage traveling wave system. Intense UV radiation produced by a flash-board was used to control the cross-sectional area of the discharge. Volume preionization was achieved by adding low ionization potential seeds (50 ppm) to the mixture. The conditions for which a 100-ns diffuse discharge can be maintained is reported. The reduced field (E/N)/ sub s/ at zero net ionization rate and the net ionization rate constant have also been measured and are reported here. 9 references, 7 figures.

21494 Statistical breakdown process in SF_6 and breakdown voltage calculations. Hauschild, W.; Exner, W. (VEB Transformatoren- und Roentgenwerk Hermann Matern, Dresden, Germany, F.R.). pp 419-429 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

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The breakdown process of uniform and slightly non-uniform electric fields in SF_6 is modeled by a stochastic birth-and-death process and an inhomogenous Poisson process. The results of this model are in agreement with experience and classic theories, and allow the derivation of the so-called generalized enlargement rule. This can be used for regarding area effects and for the optimization of SF_6 insulations. Its application is described for a compressed gas capacitor. 11 references, 6 figures.

21495 Formative time lags in SF_6-N_2 gas mixtures for different field distribution. Pfeiffer, W.; Wolf, J.; Zipfl, P. (Technische Hochschule Darmstadt, Germany, F.R.). pp 430-437 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

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This contribution deals with the formative time lags in coaxial test gaps stressed with very steep voltage pulses. The investigations were performed for different electrode arrangements and SF_6-N_2 gas mixtures with varying mixture ratio. It was demonstrated that small admixtures of SF_6 (25%) to N_2 cause a nearly identical voltage time characteristic compared with pure SF_6. The influence of the degree of homogeneity upon the voltage time characteristic of SF_6-N_2-mixtures is rather small. 6 references, 5 figures.

21496 Voltage-time characteristics of impulse breakdown in SF_6 gas. Ozawa, J. (Hitachi Ltd., Ibaraki-Ken, Japan). pp 438-444 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

From 5. international symposium on gaseous dielectrics; Knoxville, TN, USA (3 May 1987).

This paper calculates the lowest limit of voltage-time (V-t) characteristics of impulse breakdown for a concentric cylinder gap in SF_6 gas. The calculation program is developed by introducing the streamer theory and streamer development phenomena in the gas gap. V-t characteristics of the concentric cylinder gap are calculated as parameters of the applied voltage waveform, gas pressure, and size of protrusions on the inner cylinder surface. The calculated V-t characteristics agree closely with the lowest limit of the measured ones for gas pressures from 1.5 to 2.5 bar for positive polarity, but only roughly coincide for negative polarity. 6 references, 8 figures.

21497 Spacer flashover time lags in SF_6 under fast-front impulse voltages. Neilson, J.B.; Srivastava, K.D.; Naidu, S.R.; Theophilus, G.D.; de Medeiros, P.T. (British Columbia Hydro R & D, Surrey). pp 445-451 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

From 5. international symposium on gaseous dielectrics; Knoxville, TN, USA (3 May 1987).

A measurement system for studying the breakdown of insulator surfaces in sulfur hexafluoride under fast-front (10 ns rise

time) voltages is described. Measurements of volt-time characteristics have been made using 3 and 10 mm diameter rod electrodes in a rod-plane configuration with several insulator materials and geometries. The results show that insulator surfaces can have a significant effect on flashover voltage, volt-time characteristics, and flashover probability at very short times to breakdown. 4 references, 4 figures.

21498 **Breakdown voltage-time characteristics in SF_6 and SF_6 mixtures for a coaxial cylinder gap.** Li, Z.; Kuffel, E. (Univ. of Manitoba, Winnipeg). pp 452-457 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

From 5. international symposium on gaseous dielectrics; Knoxville, TN, USA (3 May 1987).

Volt-time characteristics for coaxial cylinder gaps were measured in gas mixtures comprising SF_6 with an additive c-C_4F_8 and various buffer gases including N_2 and dry air. The experimental pressure ranged from 100 kPa to 500 kPa (absolute). The test results under chopped waves with the time to chop down to 0.1 μsec are reported and discussed. For comparison purposes, data recorded for pure SF_6 and N_2 gases are also presented. 13 references, 4 figures.

21499 **Effect of field divergence on the lightning impulse breakdown of rod-plane gaps in N_2/SF_6 mixtures.** Raghavender, D.; Naidu, M.S. (Indian Institute of Science, Bangalore). pp 458-463 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

From 5. international symposium on gaseous dielectrics; Knoxville, TN, USA (3 May 1987).

Lighting impulse (1.2/50 μs) breakdown voltages (V_{50}) have been measured using a rod-plane geometry for varying field divergence. Investigations in mixtures containing 99% N_2 and 1% SF_6 were carried out for pressures of 100 to 500 kPa and gaps of 5 to 80 mm, for both positive and negative voltages. Results show that, in general, substantial improvement in V_{50} can be achieved at all gaps, particularly for pressures up to 300 kPa, with the addition of 1% SF_6 to N_2 under both the positive and negative voltages applied to the rod. The improvement in breakdown strength is more pronounced under most divergent fields; increasing with the increase in rod diameter, from 1.5 mm to 3 mm. The breakdown appears to be corona stabilized over a wide range of mixture pressures in the negative rod-plane gaps as compared to the positive rod-plane gaps. 9 references, 5 figures.

21500 **Free particle initiated breakdown of SF_6 under voltages of different time dependence.** Vlastos, A.E.; Ming, L. (Chalmers Univ. of Technology, Gothenburg, Sweden). pp 464-469 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

From 5. international symposium on gaseous dielectrics; Knoxville, TN, USA (3 May 1987).

The influence of the length, diameter and number of free aluminium particles made of aluminium wire (diameter 0.3 to 1.0 mm, length 2 to 14 mm, number 1 to 16) on the breakdown voltage of SF_6 at a pressure up to 3.5 bar was examined in a 200/90 mm concentric sphere electrode system using voltages of different time dependence, namely alternating, direct, lightning impulse, and switching impulse voltages. 4 references, 3 figures.

21501 **Manufacturer's experience in the cyclic use of SF_6 gas.** Boudiak, J.P. pp 483-490 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

From 5. international symposium on gaseous dielectrics; Knoxville, TN, USA (3 May 1987).

The company has produced electrical equipment for over 20 years. SF_6 gas is used in this equipment for insulation and high current interruption. This paper describes the techniques employed to ensure safe and economic use of SF_6 throughout the different areas of the company. The paper describes the working procedures with pure SF_6 (leak testing of SF_6 enclosures; filling and testing of assemblies; filling and leak checking of high voltage outdoor circuit breakers and GIS; filling and leak checking of medium voltage Ringmain units, contractors, and circuit breakers) and working procedures with decomposed SF_6 (protective equipment, purge of SF_6, opening of the poles, washing of the components, solid by-products). The disposal department and the effect of SF_6 on personnel are also discussed briefly. 7 references, 6 figures, 1 table.

21502 **Volt-time curves of disconnector-generated fast transients inside GIS.** Reynders, J.P.; Modry, R.; Meppelink, J. (Univ. of the Witwatersrand, South Africa). pp 491-498 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

From 5. international symposium on gaseous dielectrics; Knoxville, TN, USA (3 May 1987).

This paper presents the results of an experimental investigation of volt-time characteristics of a coaxial arrangement (180/110 mm) insulated with SF_6 gas at various pressures (0.1-0.4 MPa) and stressed with positive and negative polarity oscillating transient voltages, having an initial step rise time of 4-7 ns, a front steepness of 10-15 MV/μs and oscillating at 14 MHz. Volt-time curves for these transients in the 24 - 2000 ns time range are plotted in order to obtain an overall picture from the insulation co-ordination point of view and theoretical and measured volt-time curves for lightning for the same coaxial geometry were obtained. By plotting all these volt-time curves on the same graph, time spectra ranging from 24 ns to 10 μs are covered, and the discontinuity between lightning and fast transient volt-time curves is observed. At high voltage levels, breakdown with negative transients occurs mainly on the tail whereas with high positive transients, breakdown occurs on the front. 10 references, 5 figures, 1 table.

21503 **Insulation characteristics of separate cooling sheet winding-type gas-insulated transformer.** Goto, K.; Yamazaki, T.; Okubo, H.; Ikeda, M.; Uehara, K.; Yanabu, S. (Tokyo Electric Power Co., Inc., Japan). pp 499-506 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

From 5. international symposium on gaseous dielectrics; Knoxville, TN, USA (3 May 1987).

This paper describes the insulation characteristics of SF_6 gas-insulated, high-voltage, large-capacity transformer. This transformer is based on a new concept of separate cooling, aluminum sheet winding, and polymeric film/gas insulation. Regarding insulation development of this transformer, turn-to-turn insulation characteristics were clarified, and long-term reliability was confirmed. End insulation of sheet winding in SF_6 gas was investigated, and its impulse test results are discussed with electric field calculation. These experimental results of the insulating component of the winding are summarized, and a single-phase prototype transformer rated 275 kV-50MVA was developed. 2 references, 6 figures, 2 tables.

21504 **Recovery strength of SF_6-insulated gaps stressed by double lightning impulse voltages.** Koenig, D.; Imgrund, G.; Meppelink, J.; Grandl, J. (Technical Univ., Darmstadt, Germany, F.R.). pp 507-512 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

From 5. international symposium on gaseous dielectrics; Knoxville, TN, USA (3 May 1987).

Within the scope of simulation tests concerning GIS-disconnectors the recovery behavior of an SF_6-insulated rod-to-plane electrode configuration was investigated by a computerized impulse voltage generating system. The set-up consists of two decoupled Marx generators connected in parallel, with the help of which the test object is stressed by two positive lightning impulses within an adjustable time interval of 0.5 ms ... 80 ms. The recovery strength dependence on time was found by large scale tests, evaluated statistically. 7 references, 6 figures.

21505 **Conduction currents in gas-insulated switchgear for low level dc stress.** Fujimoto, N. (Ontario Hydro, Toronto). pp 513-519 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

From 5. international symposium on gaseous dielectrics; Knoxville, TN, USA (3 May 1987).

Opening operations of disconnectors in gas-insulated substations (GIS) are known to leave trapped charge on the load side switchgear. The trapped charge, which has a decay time constant of many hours for a capacitive load, has a value which is statistical and dependent on the design of the disconnector but is usually about 10-60% of the peak line-to-ground operating voltage. The dc stress caused by the trapped charge and the non-ideal condition of commercial GIS conductors (i.e. with varying surface roughness, contaminants and defects) result in low level conduction currents flowing between the two electrodes. Measurements have been made of these conduction currents in coaxial geometry using commercial grade conductors which indicate that currents can be much higher than can be accounted for by ion generation by external radiation. The investigations were motivated by the implications for the practical operation of gas-insulated switchgear. For instance, conduction currents are a source of negative ions, which are a primary source of discharge-initiating electrons. The negative ion density affects the statistical time lag and hence the breakdown probability. Low-level currents may also contribute to the accumulation of static charges on the surface of epoxy spacers. Such charges would cause a pre-stressing in the vicinity of spacers (with an increased failure probability) for surges of opposite polarity such as might be generated by a subsequent closing operation of the same disconnector. 14 references, 4 figures.

21506 **Effects of electrode surface roughness on dark current and switching impulse breakdown voltage in compressed SF_6 gas.** Kobayashi, S.; Murase, H.; Okubo, H.; Aoyagi, H.; Yanabu, S. (Tokyo Electric Power Company, Inc., Japan). pp 520-525 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

From 5. international symposium on gaseous dielectrics; Knoxville, TN, USA (3 May 1987).

Effects of an electrode surface roughness on the dark current, the switching impulse breakdown voltage and its dispersion were examined under the condition of 0.7 MPa SF_6 gas pressure and the maximum surface protrusion height between 0.6 and 12 μm. Smoother electrode surface give the lower dark current which varies irregularly at each time of voltage application and they give the larger breakdown voltage dispersion. On the contrary, rougher electrode surfaces give the higher dark current which varies regularly and the smaller dispersion. Many light emission spots were observed by an image intensifier, and the light emission behavior changed significantly depending on the applied voltage polarity. From the investigations it is concluded that the breakdown voltage and its dispersion depend strongly on the statistical behavior of dark current which is affected by electrode surface roughness and applied voltage polarity. 6 references, 4 figures, 1 table.

21507 **Mixing rates and diffusion of various gases and moisture into SF_6.** Castonguay, J. (Institut de Recherche d'Hydro, Varennes, Quebec). pp 526-535 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

From 5. international symposium on gaseous dielectrics; Knoxville, TN, USA (3 May 1987).

This paper describes the results of diffusion experiments performed in a cylindrical vessel (2 m long) simulating the geometry of GIS (gas-insulated substation) compartments. The horizontal and vertical mixing rates of a wide variety of gases (air, N_2, CO_2, CH_4, CHF_3, CF_4, C_2F_6, C_3F_8, cyclo-C_4F_8) with SF_6 were measured at a pressure slightly above atmospheric. The diffusion behavior of polar molecules methanol and water vapors was also studied. A sensitive gas chromatographic system developed for automatic analysis of humidity is characterized by its very low consumption of the gas sample: less than 20 ml (NPT) per analysis. This system allows long-term study of the transport of water vapor resulting from part of the test vessel being maintained below freezing temperature. The experimental diffusion coefficients of the different gases are calculated from Fisk's second law and compared to computer simulations. Theoretical values computed from the Lennard-Jones potential model are also presented and discussed. 3 references, 6 figures, 5 tables.

21508 **Surface changes induced by low kinetic energy products from corona discharge on epoxy resin in air.** Jestin, P.; Goldman, M.; Barrault, M.; Amouroux, J. (Societe Merlin-Gerin, Grenoble, France). pp 537-545 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

From 5. international symposium on gaseous dielectrics; Knoxville, TN, USA (3 May 1987).

Low kinetic energy particles (~ 0.1 eV), ions and neutral species, from partial discharges increase surface energy (wettability) and surface conduction of cured epoxy resin samples. Analysis of the surface energy polar and dispersion components indicates that oxidation phenomena are partially hindered by production of movable products on the surface. Partial recovery of the initial properties is obtained by rinsing out with water and interpreted in terms of chain fragment removal. Such fragments were showed off by FTIR spectroscopy. Effects from the whole of the discharge products and from neutral activated species only were compared. 13 references, 7 figures, 1 table.

21509 **Avalanches near a dielectric spacer in nitrogen gas.** Mahajan, S.M.; Sudarshan, T.S.; Dougal, R.A. (Univ. of South Carolina, Columbia). pp 546-552 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

From 5. international symposium on gaseous dielectrics; Knoxville, TN, USA (3 May 1987).

Electron avalanches were recorded near PMMA and Nylon insulator surfaces in nitrogen gas at 101.3 kPa. Photoemission from Nylon surface is believed to enhance the charge carriers in the test gap and cause significant distortion in the nature of such avalanches. The avalanches near a PMMA surface were very similar to those in the plain gas gap. 1 reference, 5 figures.

21510 **Measurement of the temporal decay of charges on insulator surfaces.** Bektas, S.I.; Somerville, I.C.; Farish, O.; Chalmers, I.D. (Univ. of Strathclyde, Glasgow, England). pp 553-559 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

From 5. international symposium on gaseous dielectrics; Knoxville, TN, USA (3 May 1987).

This paper reports measurements of the decay of surface charges on insulator surfaces. A comparison is made of the different effects of surface conductivity and of the drift of ions created in the surrounding gas by background radiation on the rate of neutralization of the surface charge. A novel charge measurement system which reduces the drift error to 60fC for a 60-sec scan is also reported. 3 references, 5 figures.

21511 **Effect of ribs on surface discharge in SF_6 gas.** Yamagiwa, T.; Endo, F.; Ozawa, J. (Hitachi, Ltd., Ibaraki-ken, Japan). pp 560-566 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

From 5. international symposium on gaseous dielectrics; Knoxville, TN, USA (3 May 1987).

Cylindrical post spacers were used to investigate fundamental effects of ribs on particle-initiated breakdown characteristics. The improvement in breakdown characteristics, obtained by attaching the ribs, changed with the distance between them. The shorter the distance was, the higher the breakdown voltage. When the distance was less than 20 to 30% of the spacer length, the breakdown voltage increased 20 to 60%. 9 references, 8 figures.

21512 **Application of ESCA in GIS spacer surface analysis.** Chu, F.Y.; Braun, J.M.; McIntyre, N.S. (Ontario Hydro Research Division, Toronto). pp 567-573 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

From 5. international symposium on gaseous dielectrics; Knoxville, TN, USA (3 May 1987).

In the presence of SF_6 decomposition products, the dielectric performance of certain types of insulators in gas insulated equipment can be adversely affected. The chemical and physical modifications of filled epoxy insulator surfaces can be probed by a

number of surface analysis techniques. This paper describes the application of ESCA (Electron Spectroscopy for Chemical Analysis) in the study of surface characteristics after the insulator surface has been exposed to SF_6 arced byproducts or has experienced low energy flashovers. The elements identified by ESCA on the insulator's surface before and after exposure are presented. The chemical shifts of the carbon and fluorine lines as a result of chemical bonding changes are observed. The extent of surface modification by the SF_6 plasma and by the neutral species under ambient exposure conditions is discussed. 3 references, 5 figures.

21513 **Study of the charge build-up on dielectrics submitted to corona discharge and aging effects.** Yumoto, M.; Goldman, A.; Goldman, M. (Laboratoire de Physique des Decharges, Gif-sur-Yvette, France). pp 574-579 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

From 5. international symposium on gaseous dielectrics; Knoxville, TN, USA (3 May 1987).

The space-charge build-up in a point-to-plane DC corona gap is studied in air by means of electrical measurements at the plane electrode, mostly with a polymer film on this electrode. It is shown that, due to the influence of charge accumulation on the polymer, the space-charge builds up laterally wider than without the polymer. But if the current flow can find a way to escape, the discharge does not completely stop and this explains some pronounced aging effects observed on insulating materials when practically no partial discharge occurs. Discharge initiation in the gas interface between the polymer and the plane electrode is also studied during the charge build-up. 8 references, 3 figures.

21514 **Influence of 60Hz AC charging of spacers on subsequent impulse flashover in compressed SF_6.** Sudhakar, C.E.; Srivastava, K.D. (Univ. of British Columbia, Vancouver). pp 580-585 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

From 5. international symposium on gaseous dielectrics; Knoxville, TN, USA (3 May 1987).

Surface charge accumulation on spacers in SF_6 under AC voltages has been measured using a capacitive probe. The effect of magnitude and duration of AC voltage application on surface charging and the effect of AC pre-charging on subsequent positive lightning impulse flashover voltages has also been studied. Both quasi-uniform and non-uniform geometries were used in this investigation. Results indicate that for quasi-uniform field AC pre-charging does not deposit significant charge on spacer and has minimal influence on the lightning impulse flashover levels. However for the non-uniform field, AC pre-charging results in spacer charging and its effect on first flashover voltage and time is random. 3 references, 6 figures.

21515 **Surface flashover of polyester, polypropylene and teflon films in low pressure SF_6 and N_2 media.** Rajan, J.S.; Sastry, K.S.A.; Lakshminarasimha, C.S. (Central Power Research Institute, Bangalore, India). pp 586-591 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

From 5. international symposium on gaseous dielectrics; Knoxville, TN, USA (3 May 1987).

Investigations on the surface flashover characteristics are reported on polymer (plane polypropylene, hazy polypropylene, polyester, and polytetrafluoro-ethylene)- gas (SF_6 and N_2) systems for pressures up to 700 Torr using both ac and dc source under uniform and non-uniform field conditions. Attempts are also made to correlate the surface flashover characteristics with the measured surface charge density. 2 references, 12 figures.

21516 **Research on conductor-plane long-gap characteristics by surface discharge analogy model.** Wang, W.D.; Li, C.R. (North China Institute of Electric Power Engineering, Beijing). pp 592-597 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

From 5. international symposium on gaseous dielectrics; Knoxville, TN, USA (3 May 1987).

Surface discharge analogy-model has been recognized as a valuable method for the prediction of long air-gap discharge characteristics, but it is only limited to rod-plane air-gap. In this paper a conductor-plane air-gap analogy-model has been developed. With the help of Lichtenberg figure technique, two different stages of surface discharge, corona streamer and gliding arc, can be distinguished on the conductor-plane model. According to our experimental results, within gap lengths of 16 m for positive switching surges, the maximum errors are not more than 6% of the test values. 8 references, 6 figures.

21517 **Surface and volume effects of interactions of internal partial discharges with solid dielectrics.** Sierota, A. (Warsaw Univ. of Technology, Poland). pp 598-603 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

From 5. international symposium on gaseous dielectrics; Knoxville, TN, USA (3 May 1987).

The surface and volume effects of interactions of different features of partial discharges with solid synthetic dielectrics stressed in ac electric field were studied in different model arrangement simulating the sources of degradation existing in real insulations. The results of aging tests have shown that dielectrics may react, macroscopically, in the manner which depends on the energy supplied to the localized active points at the contact interfaces and on the structure of surface and volume zones of the solid dielectric material surrounding the degradation source. 16 references, 3 figures, 1 table.

21518 **Fundamental knowledge and the testing of GIS - present state and future needs.** Boggs, S.A.; Wiegart, N.; Meppelink, J.; Diederich, J. (Ontario Hydro Research, Toronto). pp 605-613 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

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The type tests specified by international standards are necessary but no sufficient conditions for inservice GIS reliability. Manufacturers spend large sums of money to assure reliability of GIS through extensive design testing which goes well beyond the requirements of international standards. Obviously, the efficacy of such tests depends on choosing the correct tests, i.e., tests which will reveal most concerning the range of and limits to reliable operating conditions. Maximizing the information gained as a function of the extent of high voltage testing is important to both manufacturer and buyer. To the degree to which quantitative understanding of the relevant phenomena is available, some design tests can be avoided by substituting computation for experiment. To the degree that a good qualitative understanding of relevant phenomena is available, near-optimum design tests can be chosen and statistical analysis can be applied in the context of a reasonable model which reduces the number and variety of design tests necessary in a given situation. This paper reviews progress in dielectric quality assurance of GIS which has resulted from improved scientific knowledge of relevant phenomena and reviews those areas in which further work should have large payoffs to the engineering of GIS. 6 references, 3 figures.

21519 **Flashover damage test procedure for insulating materials in compressed SF_6.** Bennett, A.I. (Westinghouse R & D Center, Pittsburgh, PA). pp 614-620 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

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This paper describes a simple, quantitative test procedure for evaluation of the damage caused to insulating materials by intense surface flashover arcs in pressurized SF_6. In this procedure by sample of material under test is placed against a pair of electrodes; a discharge between these electrodes is initiated by a high voltage pulse, which permits a following arc from a low voltage energy storage capacitor. The surface damage to the sample, caused by this arc, is assessed by measuring the flashover voltage between the electrodes before after the arc, still in the same SF_6 atmosphere.

This test has been used in SF_6 at one and at four atmospheres, as well as in air, and could be done in many other gas atmospheres. This test procedure has been very successful in quantitatively distinguishing the abilities of various insulating materials to resist damage by surface arcs. The apparatus is compact and economical, and the test appears very suitable for evaluation of the abilities of insulating materials to resist surface arc damage in compressed-gas-insulated applications. 2 references, 4 figures, 2 tables.

21520 **Strength of typical GIS configurations with special reference to composite and combined stresses.** Bargigia, A.; Mazza, G.; Pigini, A.; Rizzi, G. (ENEL, Cologno, Italy). pp 621-628 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

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The strength of typical GIS configurations under composite stresses (overvoltages plus DC voltages applied at the same electrode) and combined stresses (AC and DC voltages applied at two terminals) is examined. The impact on GIS testing and design is considered, with special attention to one of the most critical operating conditions: switching of small capacitive currents by disconnectors. 5 references, 5 figures.

21521 **Limits to partial discharge detection - effects of sample and defect geometry.** Boggs, S.A.; Pecena, D.D.; Rizzetto, S.; Stone, G.C. (Ontario Hydro Research, Toronto). pp 629-636 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

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A careful analysis of partial discharge detection for the case of a void within a solid dielectric casting indicates that the apparent partial discharge PD sensitivity varies inversely with testpiece scaling and does not depend, as often stated, on testpiece capacitance. Thus the large castings used in the highest voltage class equipment and usually at the highest operating stresses are tested with the lowest real sensitivity. A model is developed for the maximum apparent (PD) magnitude from a void of given volume, shape, and position within a casting. Data supporting the validity of the model are provided over a limited range of parameters. Graphs are provided from which the apparent PD magnitude of a void within a coaxial casting can be estimated. These data can be extended to arbitrary geometries through the use of field plotting programs. 9 references, 4 figures, 1 table.

21522 **Broad band pulse detection studies of corona and breakdown in air, N_2, O_2, CO_2, SF_6 and SF_6-N_2 mixtures.** Kulkarni, S.V.; Nema, R.S. (Indian Institute of Science, Bangalore). pp 637-642 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

From 5. international symposium on gaseous dielectrics; Knoxville, TN, USA (3 May 1987).

Experiments were conducted to detect corona and breakdown pulses using a broad band detection system. The effects of circuit parameters, u.v. irradiation, field conditions (from uniform to extremely nonuniform fields), overvoltage, pressure (0.668 kPa - 91.22 kPa), distance, (0.05 cm - 1.5 cm) and gas composition were studied in detail. Many interesting results like pulsating nature of the discharge, effect of u.v. irradiation under different field nonuniformities, the behavior of the Trichel pulses in the presence of u.v. irradiation and the oscillatory (burst) nature of corona pulses in SF_6 were observed. 11 references, 3 figures.

21523 **Group discussion on new diagnostic techniques.** Tahiliani, V.H.; Sauers, I. pp 643-650 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

From 5. international symposium on gaseous dielectrics; Knoxville, TN, USA (3 May 1987).

The discussion includes any tool that could be construed as diagnostic, meaning any tool that would be used by researchers, manufacturers, and utilities. Seven short talks are presented on different methods which are then discussed by all participants. The titles of these talks are: Large apparatus image delay lenses; Optical measurements of currents in gases; New diagnostic techniques using electro-optic and magnetic-optic studies of electron beam discharges; How to prevent faults; Advanced techniques for by-product detection; IR imaging systems for GIS; and Diagnostic systems as they are applied today in Japan.

21524 **Group discussion on gas-insulated transformers and DC GIS.** Pachot, J.J.; Bouldin, D.W. pp 651-658 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

From 5. international symposium on gaseous dielectrics; Knoxville, TN, USA (3 May 1987).

This group discussed the advantages of gas-insulated transformers and switchgear, items which need to be considered in the development of this equipment (insulation system, cooling system, tests for quality assurance and aging), and items which need to be considered in designing equipment for dc applications (effect of contamination, charge accumulation on spacers, breakdown voltages under normal operation as well as under stress, and thermal environment in which it will be used). Overall it was concluded that development of GIS and GIT needs to be accelerated if these systems are to be available in the next five to ten years.

21525 **Group discussion on gas engineering for modern technologies: input from basic data.** Kristiansen, M.; Hunter, S.R. pp 659-669 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

From 5. international symposium on gaseous dielectrics; Knoxville, TN, USA (3 May 1987).

Several major discussion topics were presented and are summarized as follows. An international data base system is needed where users of basic data can easily locate the data they require. The uniqueness of electron collision cross sections which are based solely on swarm measurement data was questioned. There were also discussions on the way transient discharge effects should be modeled. A need was expressed for electron collision cross sections from individual vibrational levels of a molecule. The need for greater interaction between the users and the providers of basic data was emphasized. Finally the question of whether the performance of gas discharge devices can be improved using the principles of gas engineering was discussed.

2002 Environmental Control Technology

REFER ALSO TO CITATION(S) 20917, 21444, 22351, 22355, 22748, 22841

21526 **The kinetic rate of SO/sub 2/ sorption by CaO.** Simons, G.A.; Garman, A.R.; Boni, A.A. (Physical Sciences Inc., Andover, MA 01810). *A.I.Ch.E. Journal (New York);* **33**: No. 2, 211-217(Feb 1987).

The intrinsic rate constant for the rate of reaction of SO/sub 2/ with porous CaO in an excess of O/sub 2/ to form CaSO/sub 4/ has been determined from SO/sub 2/ sorption data on a wide range of particle diameters (1μm-1mm), SO/sub 2/ partial pressures (60 Pa to 5 kPa), and temperatures (973-1,478K). An intrinsic SO/sub 2/ reaction order of unity has been validated through current fixed-bed experiments in the 60 to 300 Pa SO/sub 2/ partial pressure range, while fluidized-bed data were used to validate the reaction order from 500 Pa to 5 kPa SO/sub 2/ partial pressure. The absolute value of the rate constant and the activation energy was derived from data on small (1 μm) particles, which approach the limit of kinetic control. While analysis of this data base dose minimize the role of intraparticle diffusion through the porous sorbent particle, the filling of the small pores by the product deposits and the associated loss of internal surface area is critical to the data reduction. It is believed that the intrinsic rate constant is known to the accuracy to which the reactivity and the BET surface area may be measured.

2003 Power Transmission And Distribution

REFER ALSO TO CITATION(S) 21337, 21468, 21471, 21514, 21516

21527 **(EPRI-EL—5291-Vol.1) Reliability evaluation for large-scale bulk transmission systems: Volume 1, Comparative evaluation, method development, and recommendations: Final report.** Lam, B.P.; Lawrence, D.J.; Reppen, N.D.; Ringlee, R.J. (Power Technologies, Inc., Schenectady, NY (USA)). Jan 1988. 406p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920201/JAW.

This volume (1 of 2) contains a comparative evaluation of existing transmission system reliability programs (SYREL, GATOR, RECS) and relevant mathematical methods for transmission reliability analysis. Several new and enhanced methods in the areas of network analysis, contingency selection, remedial action, and reliability index calculation, developed and tested during the project, are described. Recommendations for methods to be used in a production grade transmission reliability assessment program are presented. 69 figs., 41 tabs.

21528 **(EPRI-EL—5299-Vol.1) Mathematical decomposition techniques for power system expansion planning: Volume 1, Decomposition methods and uses: Final report.** Granville, S.; Pereira, M.V.F.; Dantzig, G.B.; Avi-Itzhak, B.; Avriel, M.; Monticelli, A.; Pinto, L.M.V.G. (Stanford Univ., CA (USA). Systems Optimization Lab.). Feb 1988. 165p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920207/JAW.

The objective of the long-term expansion planning is to determine when and where to build new equipment for generation and power lines for transmission of electricity. Since such problems are usually very large and complex, planners traditionally "decompose" the power system into separate subproblems using "engineering judgment." Up to now, however, there has been no systematic verification that the results are consistent and provide unbiased solutions. This volume is concerned with overcoming certain deficiences with these traditional methods for decoupling the system into subproblems and the subsequent combining of the solutions of the subs to obtain a plan for the full system. 41 figs., 13 tabs.

21529 **(EPRI-EL—5299-Vol.2) Mathematical decomposition techniques for power system expansion planning: Volume 2, Analysis of the linearized power flow model using the bender decomposition technique: Final report.** Granville, S.; Pereira, M.V.F.; Dantzig, G.B.; Avi-Itzhak, B.; Avriel, M.; Monticelli, A.; Pinto, L.M.V.G. (Stanford Univ., CA (USA). Systems Optimization Lab.). Feb 1988. 189p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920206/JAW.

In this volume, we examine several aspects of the transmission expansion problem when the network is represented by a linearized power flow model. If transmission line capacities are represented by continuous variables, we show how to apply the generalized Benders decomposition algorithm to obtain a locally optimum solution which may be globally optimum but cannot guaranteed to be so. Nevertheless, if carefully applied, this approach can be very useful for practical purposes. The MINOS nonlinear programming software system can be an important tool to deal with the nonlinearities in the analysis of the optimal expansion of the transmission system. If the system has locally optimal solutions that are not globally optimum, we have observed on problems with realistic data, that both the MINOS nonlinear algorithm and the Benders decomposition algorithm may converge to them. When investments on transmission lines are constrained to be integer values, we present an alternative formulation for the problem based on the compensation theorem of the linearized power flow model. The advantage of this formulation is that it reduces the original problem to a mixed zero-one linear programming problem that can be solved using the Benders decomposition algorithm. It is quaranteed to converge to a global optimal solution. 39 figs.

21530 **(EPRI-EL—5299-Vol.3) Mathematical decomposition techniques for power system expansion planning: Volume 3, An integrated methodology for VAR sources planning: Final report.** Granville, S.; Pereira, M.V.F.; Dantzig, G.B.; Avi-Itzhak, B.; Avriel, M.; Monticelli, A.; Pinto, L.M.V.G. (Stanford Univ., CA (USA). Dept. of Operations Research). Feb 1988. 60p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920200/JAW.

The objective of reactive sources optimization is to determine a minimum cost expansion plan for guarantees feasible operation both in normal state and under contingency situations. A two-level hierachical approach to the problem has been proposed. The reactive source optimization problem is decomposed into two parts: (1) the investment subproblem, where decisions about the location and size of new VAR sources are made; and (2) the operation subproblem, in which these sources are used to optimize the system operation. The global solution is obtained by the iterative solution of the investment and operation subproblems. This volume describes the development and implementation of the new methodology. Test results with the IEEE 118-bus system illustrating the various capabilities of the approach are discussed. The interactions between reactive sources optimization and transmission system planning are analyzed. 9 refs., 14 figs., 6 tabs.

21531 **(EPRI-EL—5299-Vol.4) Mathematical decomposition techniques for power system expansion planning: Volume 4, Security-constrained optimal power flow with postcontingency corrective rescheduling: Final report.** Granville, S.; Pereira, M.V.F.; Dantzig, G.B.; Avi-Itzhak, B.; Avriel, M.; Monticelli, A. (Stanford Univ., CA (USA). Dept. of Operations Research). Feb 1988. 65p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920205/JAW.

This volume describes a mathematical framework for the solution of the security-constrained dispatch that can take into account the system rescheduling capabilities. The methodology is based on mathematical programming decomposition techniques that allow the iterative solution of a "base-case" economic dispatch and separate contingency analysis with generating rescheduling to eliminate constraint violations. The preventive control actions are implemented from linear constraints, known as feasibility cuts, that are generated on the contingency analysis and sent to the economic dispatch problem. The resulting dispatch has the same security level as the usual security-constrained dispatch, but with lower operating costs. Case studies with the IEEE 118-bus system are presented and discussed. Further extensions of the methodology to include other corrective schemes and probabilistic aspects are also discussed. 13 refs., 8 figs., 13 tabs.

21532 **(EPRI-EL—5299-Vol.5) Mathematical decomposition techniques for power system expansion planning: Volume 5, Use of parallel computers for multi-area expansion planning: Preliminary results, Final report.** Granville, S.; Pereira, M.V.F.; Dantzig, G.B.; Avi-Itzhak, B.; Avriel, M.; Monticelli, A.; Pinto, L.M.V.G. (Stanford Univ., CA (USA). Systems Optimization Lab.). Feb 1988. 96p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920203/JAW.

The expansion planning problem under uncertainty is the central problem of our research. The problem is to find an expansion schedule which minimizes total discounted capital expenditures and operating costs over a long time frame subject to specified levels of reliability of a multi-area electric utility system. To test methodology described in Volume 1 of this report, models of two multi-area systems, one in the East and another in the West, were constructed. The east-coast system is purely illustrative with imaginary input data. The data for the western one is more realistic and we continue to make it more so. When the current project terminated October 14, 1986, work was underway to update its data and to improve its formulation. The reader is therefore cautioned to view all the outputs of model runs presented in this report as tests of methodology. The decomposition model consists of a master program, which evaluates the overall costs, and a multiple-area planning problem in a multi-period time frame. Investment decisions are made in the master program and passed to the "subprob-

lems," for each timer period, which return their results in the form of sensitivity analyses. These are then incorporated into the "master" problem, determining a new set of capital acquisitions, until an optimal solution is reached. 36 refs., 11 figs.

21533 **Excitation and ionization coefficients.** Phelps, A.V. (National Bureau of Standards, Boulder, CO). pp 1-9 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

From 5. international symposium on gaseous dielectrics; Knoxville, TN, USA (3 May 1987).

The present status of theoretical calculations of excitation and ionization coefficients for electrons in some of the simpler molecular gases and their mixtures used as dielectrics are reviewed. Illustrative comparisons with experiment are made. Detailed discussions of cross section data and results of Boltzmann calculations are presented for N_2, O_2, dry air, moist air and SF_6. 43 references, 5 figures.

21534 **Development of +/- 500 kV HVDC gas-insulated switchgears.** Nitta, T.; Arahata, Y. (Mitsubishi Electric Corp., Amagasaki, Japan). pp 471-482 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

From 5. international symposium on gaseous dielectrics; Knoxville, TN, USA (3 May 1987).

A prototype +/- 500 kV DC-GIS has been developed to demonstrate the feasibility of the new technology for a high reliability DC power transmission in the future. Solid insulators for HVDC gas insulation are key components to be used in all the equipment in the DC-GIS. The accumulation of the static electrical charges on the spacers under continuous DC stress is the most important factor in the design of the spacers. Fundamental features of the charge accumulation have been clarified. A new scavenging technique of metallic particles effective in DC gas insulation has been developed to apply to the gas insulated buses in the DC-GIS. Metal oxide nonlinear resistor for DC arresters is another key component introduced in the development. Based on these basic studies, the components of the +/- 500 kV DC-GIS have been developed and tested. Finally, these components are assembled into a full DC-GIS and subjected to a long term endurance test. 5 references, 17 figures, 1 table.

21 NUCLEAR POWER PLANTS

REFER ALSO TO CITATION(S) 22310, 22324

21535 **(EUR—9869-Vol.2) Reactor dosimetry: Dosimetry methods for fuels, cladding and structural materials, Volume 2: Proceedings.** Genthon, J.P.; Roettger, H. (eds.). (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France); Commission of the European Communities, Petten (Netherlands). Joint Research Centre). 1985. 506p. (CONF-840902—Vol.2). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88900319/JAW.

From 5. ASTM-Euratom symposium on reactor dosimetry; Geesthacht, F.R. Germany (24 Sep 1984).

The theme of the Symposium, the Proceedings of which appear in this book (volume 2 of 2) was again radiation metrology techniques, data bases and standardization. The Symposium was attended by more than 100 delegates from 15 countries and all contributions are included. In addition, the book contains papers submitted for publication only, the chairmen's report on nine workshops and a summary of highlights. This valuable reference source on radiation dosimetry is divided into nine major sections: LWR-PV surveillance; Fast Reactors; Fusion and Spallation; Techniques; Damage Models, Physics, Dosimetry and Materials; Neutron and Gamma Spectrum Determination; Benchmarks, Reference and Standard Spectra; Nuclear Data; General Interest.

21536 **(NUREG—0020-Vol.11-No.12) Licensed operating reactors: Status summary report, Data as of November 30, 1987.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Computer and Telecommunications Services). Jan 1988. 476p. NTIS, PC A21/MF A01 - GPO. Order Number TI88900333/JAW.

The Operating Units Status Report - Licensed Operating Reactors provides data on the operation of nuclear units as timely and accurately as possible. This information is collected by the Office of Administration and Resources Management from the headquarters staff of NRC's Office of Enforcement (OE), from NRC's Regional Offices, and from utilities. The three sections of the report are: monthly highlights and statistics for commercial operating units, and errata from previously reported data; a compilation of detailed information on each unit, provided by NRC's Regional Offices, OE Headquarters and the utilities; and an appendix for miscellaneous information such as spent fuel storage capability, reactor-years of experience and non-power reactors in the US. It is hoped the report is helpful to all agencies and individuals interested in maintaining an awareness of the US energy situation as a whole.

21537 **Using component test data to develop failure probabilities and improve seismic performance.** Holman, G.S.; Chou, C.K. (Lawrence Livermore National Lab., CA, USA). pp 313-325 of Transactions of the 9th international conference on structural mechanics in reactor technology. Vol. A. Indexes, abbreviations, supplement. Wittmann, F.H. (ed.). Rotterdam, Netherlands; Balkema (1987). (CONF-870812—).

From 9. SMIRT: international conference on structural mechanics in reactor technology; Lausanne, Switzerland (17 Aug 1987).

This paper presents an approach to fragility testing which can provide the following while remaining within practical constraints on time and resources: 1. More realistic component failure probabilities for PRA applications. Improved descriptions of component fragility, based on actual failure data, will reduce the uncertainty inherent in subjective fragilities drawn from design information and results of equipment qualification testing. 2. Better understanding of component failure modes, or how various individual factors affect failure, and of the real 'margin' between design or qualification requirements and conditions that might actually cause failure. This understanding also provides a basis for enhancing the seismic capacity of critical equipment through specific hardware modifications. 3. Guidance for development of seismic review procedures for existing plants, for interpretation of existing qualification or fragility data, and for specification of test procedures of equipment for which in-depth testing to 'failure' is warranted.

2101 Power Reactors, Non-breeding, Light-water Moderated, Boiling Water Cooled

REFER ALSO TO CITATION(S) 21633, 21647, 21648, 21651, 21669, 21672, 23896

21538 **(ENEA-RT-TIB—85-6) Monte Carlo calculation for a benchmark on interactive effects of Gadolinium poisoned pins in BWRs.** Borgia, M.G.; Casali, F.; Cepraga, D. (ENEA, Rome (Italy)). 1985. 45p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701000/JAW.

K infinite and burn-up calculations have been done in the frame of a benchmark organized by Physic Reactor Committee of NEA. The calculations, performed by the Monte Carlo code KIM, concerned BWR lattices having UO*L2 fuel rodlets with and without gadolinium oxide.

21539 **(NUREG/CR—5009) Assessment of the use of extended burnup fuel in light water power reactors.** Baker, D.A.; Bailey, W.J.; Beyer, C.E.; Bold, F.C.; Tawil, J.J. (Pacific Northwest Lab., Richland, WA (USA)). Feb 1988. Contract AC06-76RL01830. 94p. (PNL—6258). NTIS, PC A05/MF A01 - GPO. Order Number TI88006080/JAW.

This study has been conducted by Pacific Northwest Laboratory for the US Nuclear Regulatory Commission to review the environmental and economic impacts associated with the use of ex-

tended burnup nuclear fuel in light water power reactors. It has been proposed that current batch average burnup levels of 33 GWd/t uranium be increased to above 50 GWd/t. The environmental effects of extending fuel burnup during normal operations and during accident events and the economic effects of cost changes on the fuel cycle are discussed in this report. The physical effects of extended burnup on the fuel and the fuel assembly are also presented as a basis for the environmental and economic assessments. Environmentally, this burnup increase would have no significant impact over that of normal burnup. Economically, the increased burnup would have favorable effects, consisting primarily of a reduction: (1) total fuel requirements; (2) reactor downtime for fuel replacement; (3) the number of fuel shipments to and from reactor sites; and (4) repository storage requirements. 61 refs., 4 figs., 27 tabs.

21540 **Probability of failure in BWR reactor coolant piping.** Holman, G.S.; Lo, T.; Chou, C.K. (Lawrence Livermore National Lab., CA, USA). pp 39-48 of Transactions of the 9th international conference on structural mechanics in reactor technology. Vol. A. Indexes, abbreviations, supplement. Wittmann, F.H. (ed.). Rotterdam, Netherlands; Balkema (1987). (CONF-870812—).

From 9. SMIRT: international conference on structural mechanics in reactor technology; Lausanne, Switzerland (17 Aug 1987).

The results show that IGSCC dominates the probability of direct DEGB in recirculation piping fabricated from Type 304 stainless steel. In general, we have observed that: 1. Residual stresses appear to be the dominant factor influencing the number of cracks initiated and, to a lesser degree, their growth rates. In the absence of IGSCC, thermal stresses dominate the probability of direct DEGB; earthquakes contribute only negligibly. 2. Initiated cracks always dominate the probability of leak (and by inference, break probabilities as well) in Type 304 Stainless Steel piping. By contrast, the influence of initiated cracks in Type 316NG piping first becomes apparent after about 12 years of operation. 3. The per-weld probability of leak in Type 316NG piping is between two and three orders of magnitude lower than that in piping fabricated from Type 304 stainless steel. Based on our past experience, this trend should hold true for break probabilities as well.

2102 Power Reactors, Non-breeding, Light-water Moderated, Non-boiling Water Cooled

REFER ALSO TO CITATION(S) 21043, 21044, 21539, 21607, 21616, 21625, 21626, 21644, 21647, 21648, 21649, 21651, 21668, 21670, 21671, 21672, 21981, 22065, 23972, 23973

21541 **(CEA-CONF—9045) Vibration of helical springs in cross water flow.** Axisa, F.; Brunet, G.; Canat, J.N. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. d'Etudes Mecaniques et Thermiques). May 1987. 26p. (CONF-870582—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752131/JAW.

From International conference on flow induced vibrations; Bowness-on-Windermere, UK (12 May 1987).

The purpose of this paper is to present new experimental data on vortex-shedding induced vibration on helical springs subjected to cross-flows. Intense locked-in vibration were observed on the natural modes of axial displacement. A simplified model is tentatively proposed to interpret the experimental data which is based on an analogy with vortex-shedding as observed on straight tube rows.

21542 **(CNEN-DR-GTT—01/87) Present stage evaluation of Furnas calculus methodology qualification.** (Comissao Nacional de Energia Nuclear de Brasil, Rio de Janeiro. Dept. de Reatores). Jul 1987. 21p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701547/JAW.

This technical note is about the present stage evaluation of FURNAS Calculus Methodology Qualification related to reload licensing process and licensing support of operation questions of Angra 1 NPP concerning transient and Core ThermalHydraulic areas.

21543 **(CNEN-DR-GTT—03/87) Present stage of Furna's calculus methodology qualification concerning large loss of coolant accident analysis.** (Comissao Nacional de Energia Nuclear de Brasil, Rio de Janeiro. Dept. de Reatores). Oct 1987. 16p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701548/JAW.

This technical note describes the present stage of FURNAS's calculus methodoly qualification concerning Large Loss of Coolant Accident Analysis of Angra 1 NPP.

21544 **(DOE/NE—0084-Rev.1) Overall plant design descriptions: VVER water-cooled, water-moderated energy reactor: Revision 1.** (USDOE Assistant Secretary for Nuclear Energy, Washington, DC). Oct 1987. 371p. NTIS (US Sales Only), PC A16/MF A01; 1; GPO Dep. Order Number DE88006566/JAW.

This report provides information concerning the Soviet designed water cooled, water moderated energy reactor, the VVER. Information is presented on the history and general characteristics of VVER's, electrical systems, buildings and structures, reactor system, fuel handling, storage, and transportation, heat transport system, balance of plant systems, instrumentation, control, and emergency protection (AZ) systems, materials, water chemistry of VVER plants, and seismic considerations. (JDB)

21545 **(EPRI-NP—5592) Evaluation of steam generator chemical hideout at the Prairie Island PWR: Final report.** Palino, G.F.; Clouse, M.E.; Sawochka, S.G. (NWT Corp., San Jose, CA (USA)). Feb 1988. 69p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920215/JAW.

A study was performed at the Prairie Island Unit 2 PWR to quantify hideout in the steam generators. During the study, the reactor was at approximately 56% power. A solution of potassium nitrate and potassium chloride was injected at a precisely known concentration and rate for 25 hours into the feedwater to the steam generators. The injection period was sufficient to achieve equilibrium concentrations in the steam generators. Cation conductivity and impurity concentrations were monitored in the steam genrator blowdowns and throughout the system. Mass balance calculations were performed around the steam generators to estimate the hideout fraction and hideout rate constants for each of the injected species.

21546 **(EPRI-NP—5594) Effects of alternate pH control additives on PWR secondary cycle chemistry: Final report.** Sawochka, S.G.; Clouse, M.E.; Miller, M.R.; Friedman, K.A.; Wall, P.S. (NWT Corp., San Jose, CA (USA)). Feb 1988. 127p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920214/JAW.

Use of morpholine as a pH control additive at Prairie Island and Beaver Valley significantly reduced iron levels in the condensate and feedwater. This impact is attributed primarily to the increase in liquid film pH in two-phase regions as a result of the lower steam/liquid distribution coefficient of morpholine compared to ammonia. Although results indicate that morpholine does not increase blowdown removal efficiency compared to ammonia, the reduction in feedwater iron transport is sufficient to significantly reduce sludge buildup in the steam generators. Decomposition of morpholine leads to formation of formic and acetic acids which increase blowdown cation conductivity. However, the observed increase is less than 0.2 uS/cm, and the sensitivity of cation conductivity to strong acid anions does not decrease significantly. Use of 2-amino-2-methyl-l-propanol and dimethyl-amino-propanol (AMP-DMAP) as an alternate pH control additive at Fort Calhoun (approximately 0.4 ppM in the feed-water) had no significant beneficial effect on corrosion product transport compared to ammonia. In addition, acetate concentrations and the elevation in cation conductivity were much greater than the use of morpholine at Beaver Valley and Prairie Island.

21547 (EPRI-NP—5622) PWR [pressurized water reactor] pressure vessel neutron spectra at McGuire-1: Final report. Tsoulfanidis, N. (Missouri Univ., Rolla (USA). Dept. of Nuclear Engineering). Feb 1988. 73p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920213/JAW.

Includes 1 sheet of 24x reduction microfiche.

Neutron energy spectra for the McGuire-1 reactor, a PWR designed by Westinghouse and owned and operated by the Duke Power Co., have been calculated using the transport codes XSDRNPM, ANISN, and DOT-4.2. This is the third report of a series, the other two being reports containing similar information for the Arkansas Power and Light reactors ANO-1 and ANO-2. The objective of this effort is the establishment of a benchmark methodology for the most accurate computation of the fast neutron fluence hitting the Pressure Vessel of a PWR. To perform the calculations, a R-θ model of McGuire-1 was established for the 2-D transport code DOT-4.2. The R-θ neutron flux thus obtained formed the basis for a 3-D flux synthesized with the help of a "leakage factor" which was calculated, group by group, from a R-Z DOT flux and an ANISN 1-D flux. This 3-D flux was subsequently used to calculate reaction rates for several threshold foils irradiated in in-vessel and ex-vessel positions. The calculated reaction rates were compared with measured ones, when experimental data existed. Displacements per atom were also computed for several locations. As it was shown previously for ANO-1 and ANO-2, there is considerable angular variation of the flux hitting the pressure vessel. For McGuire-1, the steel pads that have been placed outside the core barrel, reduce the peak of the fast neutron flux but also move the peak from 45° to about 20°, with respect to the flat of the core which is taken as the 0° direction.

21548 (EPRI-NP—5624) Chemistry data integration in a PWR: Final report. Siegwarth, D.P.; Choi, S.S.; Friedman, K.A.; McNeill, B.D. (NWT Corp., San Jose, CA (USA); Duke Power Co., Clover, SC (USA)). Jan 1988. 73p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920177/JAW.

Steam generators and turbines in pressurized water reactor plants have experienced a variety of corrosion problems as a result of ionic, oxidizing species and corrosion product transport into the steam generators. A data acquistiion and analysis system which can assist in the reduction of amount of ionic and oxidizing species transported to the steam generators through improved secondary cycle data management and analysis is described. The system demonstration results at Duke Power Company's Catawba Power Station are given. Estimates for the system installation and operating costs are given along with the associated system benefits. 6 refs., 18 figs., 8 tabs.

21549 (FEI—1795) Effect of heterogeneity of absorbing rod position in a core formation of the reactivity temperature coefficient in uranium water assemblies. Bykovskij, V.S.; Lantsov, M.N.; Lependin, V.I.; Makarov, O.I.; Matveenko, V.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1986. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701014/JAW.

Results of calculational and experimental investigations obtained when studying reactivity temperature coefficients (RTC) in uranium-water assemblies with rho/sub H//rho/sub 5/ approx 130 depending on the way of positing the gadolinium burnable poison rods (BPR) along the core cross section: uniformly in the core centre and at its peripheral parts. RTG is determined in subcritical state by the shooting source method. The calculations are carried out in two-group diffusion approximation using (r, Z)-geometry in the FACTOR-3, DNESTR programs and (r, phi)-geometry taking account of the BPR real position in the RFI-80 program. The investigations displayed a noticeable dependence of RTG value on the way of BPR position in a core under conditions of reflector and absorbing rods concurrent contribution to the balance of assembly reactivities. 7 refs.; 2 figs.

21550 (FRADOC—11-1) Performance of Fragema fuel in pressurized water reactors. Dumont, A.; Ravier, G.; Ballot, B. (Societe Franco-Americaine de Constructions Atomiques (FRAMATOME), 92 - Courbevoie (France)). Jun 1986. 5p. (CONF-860603—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88752103/JAW.

From 4. European nuclear conference and 9. FORATOM congress (ENC '86) and international nuclear trade fair; Geneva, Switzerland (1 Jun 1986).

FRAGEMA fuel operating experience in power reactors is very extensive. Performance over a range of power and burnup levels for various operating conditions is quite satisfactory. However significant development programs are presently in progress to further extend our knowledge under increasingly severe operating conditions. In particular, upcoming data acquisition programs (1985-1988) will cover site and hot cell measurements on Gd poison rods, 4.5 % overenriched fuel rods over four operating cycles, 17 x 17 AFA fuel assemblies. For these products the same surveillance strategy as the one used for the standard assembly has been adopted, in order to continuously provide more data which can be used to upgrade design models and pave the way for the development of future products.

21551 (INIS-BR—916) Simulation of thermal behavior of nuclear fuel rod by electrically heated pin. Carajilescov, P. (Associacao Brasileira de Ciencias Mecanicas, Rio de Janeiro). 1985. 4p. (CONF-8512126—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701457/JAW.

From 8. Brazilian Congress of Mechanical Engineering; Sao Jose dos Campos, Brazil (1 Dec 1985).

The utilization of electrically heated rods for the simulation of nuclear fuel rods represents an universally adopted method by the nuclear industry to study thermalhydraulic problems. The present work represents the development of a method to obtain the time variation of the electric linear power necessary to simulate a given nuclear power transient in order to yield the same temperature and heat flux conditions in the surface of the electrical heater that would be obtained by the nuclear fuel rod.

21552 (UJV—7866-M) Evaluation of the cladding integrity on the basis of the radiation set-up in primary circuit of PWR's. Barta, O.; Beno, J.; Kapisovsky, V.; Smiesko, I. (Ustav Jaderneho Vyzkumu CSKAE, Rez (Czechoslovakia)). Oct 1986. 18p. NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701709/JAW.

A method of checking fuel cladding integrity is described, based on a gamma-spectrometric analysis of contamination with fission products of the coolant in the primary circuit. Listed are the simplifying assumptions on which the computer code for gamma spectra evaluation (DFE code) is based. A set of equations was derived for the total activities of individual fission product isotopes; the values of rate constants in the equations were either estimated or determined experimentally. The choice of suitable isotopes is justified. The reliability of the method was tested on unit 1 of the V-1 nuclear power plant immediately before shutdown for refueling, by comparing the results with those of two other methods performed during refueling. The reasonable agreement between results indicates the validity of the model underlying the DFE code. (A.K.). 8 figs.

21553 Containment response and radiological release for a TMLB' accident sequence in a large dry containment. Gasser, R.D.; Bieniarz, P.P.; Tills, J.L. (Sandia National Labs., Albuquerque, NM, USA; Risk Management Associates, Albuquerque, NM, USA; Tills, Jack and Associates, Inc., Albuquerque, NM, USA). *Nuclear Engineering and Design;* **104**: No. 3, 295-303(Nov 1987). (CONF-860507—). Contract AC04-76DP00789.

From 3. workshop on integrity of containments for nuclear power plants; Washington, DC, USA (21 May 1986).

An analysis has been performed for the Bellefonte Pressurized Water Reactor (PWR) Unit 1 to determine the containment loading and the radiological releases into the environment from a station blackout accident. A number of issues have been addressed in this analysis, which include the effects of direct heating on containment loading and the effects of fission product heating and nat-

ural convection on releases from the primary system. The results indicate that direct heating, which involves more than about 50% of the core, may fail the Bellefonte containment, but natural convection in the Reactor Coolant System (RCS) may lead to overheating and failure of the primary system piping before core slump, thus, eliminating or mitigating direct heating. Releases from the primary system are significantly increased before vessel breach, due to natural circulation, and after vessel breach, due to reevolution of retained fission products by fission product heating of RCS structures.

21554 **Fragility assessment of containment tangential shear failure.** Hwang, H.H.M.; Pepper, S.E.; Chokshi, N.C. (Brookhaven National Lab., Upton, NY, USA. Dept. of Nuclear Energy; Nuclear Regulatory Commission, Washington, DC, USA. Office of Nuclear Reactor Regulation). pp 237-242 of Transactions of the 9th international conference on structural mechanics in reactor technology. Vol. M. Structural reliability - probabilistic safety assessment. Wittmann, F.H. (ed.). Rotterdam, Netherlands; Balkema (1987). (CONF-870812—).

From 9. SMIRT: international conference on structural mechanics in reactor technology; Lausanne, Switzerland (17 Aug 1987).

This paper presents the fragility assessment of the reinforced concrete containment of the Indian Point-3 reactor with respect to the tangential shear failure. The tangential shear limit state is described in detail. The variations of material strengths such as the concrete compressive strength and reinforcement yield strength are included in the fragility analysis by using the Latin hypercube sampling technique.

2103 Power Reactors, Non-breeding, Graphite Moderated

REFER ALSO TO CITATION(S) 21603, 21634, 23073, 23951

21555 **(INIS-BR—942) Introduction to the analysis of multi-cavity prestressed concrete pressure vessels.** Silva, M.C.A.T. da. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo (Brazil)). 1986. 230p. (In Portuguese). NTIS (US Sales Only), PC A11/MF A01. Order Number TI88701597/JAW.

The present work is a study of multi-cavity prestressed concrete pressure vessels (PCRV) for nuclear reactors. A review is made of the designs, analises and models of multi-cavity concrete pressure vessels. A preliminary evaluation of the NONSAP program for applications in complex three-dimensional structures such as a multi-cavity pressure vessel is also made. A model of a PCRV of a 1000 MW(e) high-temperature gas cooled reactor was selected for a three-dimensional analysis with the NONSAP program. The results obtained are compared with experimental data.

21556 **(JAERI-M—87-007) Basic characteristics of heat-exchanger-type steam reformer heated by high-temperature helium gas. (2). Analysis by simulation model.** Okuyama, K. (Japan Atomic Energy Research Inst., Tokyo). Feb 1987. 106p. (In Japanese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE87702962/JAW.

A computer-simulation model was developed to analyze the basic characteristics of a heat-exchanger-type steam-methane reformer, which is the key component to produce hydrogen using the nuclear process heat from a high-temperature gas-cooled reactor. This model is based on the one-dimensional one taking account of heat transfer and reaction kinetics. In a previous report, the analytical model and the solution procedure are described, and an example of calculation results were shown compared with the experimental data. This report describes simulation results of the dependencies of the characteristic quantities such as heat flux, reaction rates, and hydrogen production rate in the reformer tube on selected parameters, namely, the operating conditions (inlet gas temperatures, pressure, and flow rates), the activities of the catalyst, the heat-transfer rate and the dimensions of the reaction tube.

21557 **(NIIAR—16(697)) Application of the weibull distribution to predict the extent of core depressurization for reactors of some types.** Samsonov, B.V.; Markin, S.A.; Aksenov, N.A.; Zolotukhin, V.A. (Nauchno-Issledovatel'skij Inst. Atomnykh Reaktorov, Dimitrovgrad (USSR)). 1986. 20p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703012/JAW.

Problem of predicting dispersion-type fuel-element depressurization used in research and high-temperature gas-cooled graphite-moderated reactors is considered with the application of statistic methods of reliability theory. Problems of choosing reference isotopes, from which yield a depressurization value must be determined, are discussed. Technique for determining the Veibull's distribution parameters for known and unknown sampling volumes are given as well as results of experiment when 6500 coated fuel elements were irradiated up to 13% burnup. The conclusion of the Veibull's distribution applicability for predicting radiation situation under conditions of maximum opened fuel surface has been drawn. 8 references, 4 figures, 1 table.

2104 Power Reactors, Non-breeding, Otherwise Moderated Or Unmoderated

REFER ALSO TO CITATION(S) 21591

2105 Power Reactors, Breeding

REFER ALSO TO CITATION(S) 21067, 21604, 21605, 21628, 21652

21558 **(CEA-CONF—9042) Control and balance of nuclear matters used for core fabrication of Super Phenix.** Beche, M.; Guillet, H.; Heyraud, H.; Levrard, J.; Pajot, J. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France). Inst. de Recherche Technologique et de Developpement Industriel (IRDI)). May 1987. 7p. (In French). (CONF-870519—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88752132/JAW.

From 9. annual meeting of the European Safeguards Research and Development Association: safeguards and nuclear material management; London, UK (12 May 1987).

The fabrication of the core of the fast breeder reactor set up at Creys Malville ended in March 1984. It started in 1978 and it required, for the fabrication of the 410 assemblies, the utilization of 7438 kg of plutonium. To satisfy national and international regulations, DPFER/SFER has used a methodology to follow and to control the movements of the nuclear materials. These controls are achieved by physical methods, chemical methods and empiric methods. Euratom has conducted a succession of inspections during the 5.5 years of that campaign. The inventory difference, in the fabrication of that core, represents about 0.1% of the total mass of the plutonium handled.

21559 **(CEA-CONF—9044) Fluidelastic instability of a flexible weir: non linear analysis.** Aita, S.; Benassis, T.; Gilbert, R.J.; Guilbaud, D. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. d'Etudes Mecaniques et Thermiques). May 1987. 14p. (CONF-870582—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88752129/JAW.

From International conference on flow induced vibrations; Bowness-on-Windermere, UK (12 May 1987).

A new type of fluidelastic instability was discovered during the hot tests of Super Phenix LMFBR. This instability is due to the fluid discharge, over a flexible weir shell which separates two thin fluid sheets (the feeding and restitution collectors). An analytical non-linear model was realized. The flow and force sources at the top of the collectors are described and projected on the modal basis of the system formed by the collectors and the weir shell. This model is used to estimate the vibratory level when a steady-state is reached by the effect of non-linearities. The influence of the different non-linear relations implied by the weir discharge is discussed. Comparisons of the steady-state amplitudes and behaviour in time, between calculation and measurement on the reactor are made.

They demonstrate that the model is relevant for such non-linear analysis.

21560 **(CEA-CONF—9097) 3D dynamic fluid structure coupling analysis of pool type LMFBR structures by substructuring method.** Brabant, F.; Gantenbein, F.; Gibert, R.J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. d'Etudes Mecaniques et Thermiques). Jul 1987. 8p. (CONF-870636—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88752135/JAW.

From 5. national congress on pressure vessels and piping; San Diego, CA, USA (28 Jun 1987).

A calculation method to take into account 3D geometry of shells and fluid structure interaction in pool type FBR structures is described in this paper. It is based on substructuring technique and substructures are defined by their natural modes. Application to the seismic behaviour of a reactor similar to SPX1 is made and the results of this 3D calculation are compared to those calculated by 2D model.

21561 **(CEA-DRNR—337) Hydrogen and acoustic detection in steam generators of Super Phenix power plant.** Kong, N.; Le Bris, A.; Berthier, P. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France). Dept. des Reacteurs a Neutrons Rapides). May 1986. 16p. (In French). (CONF-860501—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88752125/JAW.

From Conference on the science and technology of fast reactor safety; Channel Islands, UK (12 May 1986).

During the isothermal tests of Super-Phenix, two types of measurements were made on the steam generators with regard to the detection of water leaks into the sodium: - the first measurements enabled us to determine the characteristics (sensitivity, response time) of the hydrogen detectors that are already operational for the filling with water and the power operation of the steam generators. They also provided the basis for developing a prototype system for detecting very small water leaks (microleak phase). The other measurements concern the qualification tests of acoustic detectors which have been fitted for the first time to a major industrial installation. The results obtained are very satisfactory but final validation of the acoustic method will only occur after the full-power tests.

21562 **(CEA-DRNR-P—353) Complementary role of critical integral experiment and power reactor start-up experiments for LMFBR neutronics data and method validation.** Salvatores, M. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France). Dept. des Reacteurs a Neutrons Rapides). Sep 1986. 14p. (CONF-860906—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88752124/JAW.

From Advances in reactor physics and safety meeting; Saratoga Springs, NY, USA (17 Sep 1986).

Both critical experiments and power reactor results play at present a complementary role in reducing the uncertainties in Key design parameters for LMFBR, which can be relevant for the economic performances of this type of reactors.

21563 **(CEA-DRNR-P—354) Experimental Balzac program at Masurca in support of the design of Super Phenix 2.** Sztark, H.; d'Angelo, A.; Soule, R.; Granget, G. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France). Dept. des Reacteurs a Neutrons Rapides). Sep 1986. 26p. (CONF-860906—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752126/JAW.

From Advances in reactor physics and safety meeting; Saratoga Springs, NY, USA (17 Sep 1986).

The Balzac experimental program, performed in the Masurca critical assembly at Cadarache since 1985, is designed for the validation of the neutron physics requirements related to the physical options of the SPX2 project. Geometrically simple configurations are chosen in which parameters, typical for those physical options, are varied in a systematic manner while the basic fissile composition is kept the same. Measurements will be made especially of the critical mass, the distributions of reaction rates, spectral indices, / sup 10/B(n,α) reaction and gamma-ray heating in particular in the control-rod and in internal storage regions. Reactivity effects of (UPu)O/sub 2/ isotopic composition variations and of different control-rod absorber configurations will be also measured using the MSM technique.

21564 **(CEA-DRNR-P—357) Reactor physics activities in France November 1985-September 1986.** Golinelli, C.; Salvatores, M. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France). Dept. des Reacteurs a Neutrons Rapides). Sep 1986. 8p. (CONF-8609385—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88752121/JAW.

From 29. reunion NEACRP; Ontario, Canada (22 Sep 1986).

This paper gives the experimental and theoretical studies made in France, on fast reactor physics, between November 1985 to September 1986.

21565 **(CEA-DRNR-P—360) JEF-1 data validation on shielding neutron propagation benchmarks.** Carli, A. de; Guma, M.; Grosso, A.; Calamand, D.; Salvatores, M. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France). Dept. des Reacteurs a Neutrons Rapides). Oct 1986. 18p. (CONF-8610388—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88752122/JAW.

From NEACRP specialists meeting on shielding benchmarks; Paris, France (13 Oct 1986).

In the present paper, we give the results of JEF-1 data validation for shielding applications. We have considered the neutron propagation experiment in pure sodium performed in HARMONIE, and the iron propagation experiment, ASPIS. Both experiments are part of the shielding experimental benchmarks, submitted to the NEA Data Bank for JEF data validation. Moreover, some calculations are presented relative to the NEACRP theoretical LMFBR shielding benchmark.

21566 **(ENEA-RT-TIB—85-25) Response calculation of containment structures of a simplified fast reactor model in real scale during an HCDA by Astarte-4B code. Cont-benchmark problem.** Daneri, A.; Toselli, G. (ENEA, Frascati (Italy). Centro Ricerche Energia). 1985. 30p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701001/JAW.

This report presents the results, obtained by ASTARTE-4B code, of the reference calculation for a Benchmark concerning the internal structure and containment response following an HCDA for a simplified model of type fast reactor. This Benchmark was proposed by the working group CONT of CCE for the fast reactors. 30 figs.

21567 **(ENEA-RT-TIB—85-33) HCDA Simulation. CASSIOPEE results in the cont-benchmark problem.** Zucchini, A. (ENEA, Frascati (Italy). Centro Ricerche Energia). 1985. 23p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701002/JAW.

CASSIOPEE code for HCDA analysis in LMFBR has been successfully applied to the benchmark problem proposed by the CONT group of the CEC: the results of CASSIOPEE presented here are on the whole in satisfactory agreement with the average of the values obtained by the other main European codes. 16 fig.

21568 **(INIS-BR—912) Thermo-hydraulic simulations of the experimental fast reactor core.** Silveira Luz, M. da; Braz Filho, F.A.; Borges, E.M. (Associacao Brasileira de Ciencias Mecanicas, Rio de Janeiro). 1985. 4p. (In Portuguese). (CONF-8512126—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701453/JAW.

From 8. Brazilian Congress of Mechanical Engineering; Sao Jose dos Campos, Brazil (1 Dec 1985).

A study of the core and performance of metallic fuel of the experimental fast reactor, from the thermal-hydraulic point of view, was carried out employing the COBRA IV-I code. The good safety characteristics of this reactor and the feasibility of using metallic fuel in experimental fast reactor were demonstrated.

21569 **(INIS-BR—913) Models for the cross flow and the turbulent eddy diffusivity in bundles of rods with helical spacers.** Fernandez y Fernandez, E.; Carajilescov, P. (Associacao Brasileira de Ciencias Mecanicas, Rio de Janeiro). 1985. 4p. (In Portuguese). (CONF-8512126—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701454/JAW.

From 8. Brazilian Congress of Mechanical Engineering; Sao Jose dos Campos, Brazil (1 Dec 1985).

The fuel elements of a LMFBR type reactor consist of a bundle of rods wrapped by helical wires that work as spacers. The bundle of rods is surrounded by an hexagonal duct. Models for the channel cross flow and for the turbulent eddy diffusivity were developed. In conjunction with these models, the flow redistribution factors permit to estabish a determinist method to calculate the temperature distribution. The obtained results are compared with experimental data available in the literature and with results given by other codes. Although these codes are based on much more complex models, the comparison was very satisfactory.

21570 **(IWGFR—58) Cavitation criteria for designing mechanisms working in sodium application to pumps: Specialists' meeting, Summary report.** (International Atomic Energy Agency, Vienna (Austria). International Working Group on Fast Reactors). 1985. 289p. (CONF-8510488—). NTIS (US Sales Only), PC A13/MF A01. Order Number DE88900331/JAW.

From Specialists' meeting on cavitation criteria for designing mechanisms working in sodium application to pumps; Bensberg, F.R. Germany (28 Oct 1985).

This volume presents papers from an international meeting dealing with design of pumps for use in sodium-cooled fast breeder reactors. Papers were presented in three sessions: (1) national position papers, (2) cavitation tests and other performance tests, and (3) applications of the tests and future programs. The 21 papers in this report are indexed separately. (JDH)

21571 **(WAPD-TM—1606) End-of-life destructive examination of light water breeder reactor fuel rods (LWBR Development Program).** Richardson, K.D. (Bettis Atomic Power Lab., West Mifflin, PA (USA)). Oct 1987. Contract AC11-76PN00014. 162p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE88006586/JAW.

Destructive examination of 12 representative Light Water Breeder Reactor fuel rods was performed following successful operation in the Shippingport Atomic Power Station for 29,047 effective full power hours, about five years. Light Water Breeder Reactor fuel rods were unique in that the thorium oxide and uranium-233 oxide fuel was contained within Zircaloy-4 cladding. Destructive examinations included analysis of released fission gas; chemical analysis of the fuel to determine depletion, iodine, and cesium levels; chemical analysis of the cladding to determine hydrogen, iodine, and cesium levels; metallographic examination of the cladding, fuel, and other rod components to determine microstructural features and cladding corrosion features; and tensile testing of the irradiated cladding to determine mechanical strength. The examinations confirmed that Light Water Breeder Reactor fuel rod performance was excellent. No evidence of fuel rod failure was observed, and the fuel operating temperature was low (below 2580°F at which an increased percentage of fission gas is released). 21 refs., 80 figs., 20 tabs.

21572 **(WAPD-TM—1610) Light Water Breeder Reactor module and rod examination systems (LWBR Development Program).** Bacvinskas, W.S. (ed.). (Bettis Atomic Power Lab., West Mifflin, PA (USA)). Oct 1987. Contract AC11-76PN00014. 137p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88006587/JAW.

After successfully operating for 29,047 effective full power hours at the Shippingport Atomic Power Station, the Light Water Breeder Reactor core fuel modules were shipped to the Expended Core Facility in Idaho for further disassembly and examination. This report presents a description of the remote, underwater measuring equipment used to perform examinations on fuel modules and nondestructive examinations of fuel rods. The module examinations consisted of an as-received visual examination, bow measurement, and in-bundle rod bow and gap measurement of as-received and partially derodded modules. The nondestructive rod examinations performed were length measurement, visual examination, free hanging bow measurement, diameter measurement, oxide thickness measurement, cladding defect examination, plenum ovality measurements, and wear mark depth and volume measurement. Qualification of the equipment to confirm that all measurement requirements were met is also discussed. Equipment qualification and operation has shown the module bow measurements were accurate within +-0.005 inch, and fuel rod diameter, plenum ovality, and wear mark characterization were accurate within +-0.0002 inch.

21573 **Fission gas retention in irradiated metallic fuel.** Fenske, G.R.; Gruber, E.; Kramer, J.M. (Argonne National Lab., IL, USA). pp 3-9 of Transactions of the 9th international conference on structural mechanics in reactor technology. Vol. C. Fuel elements and assemblies. Wittmann, F.H. (ed.). Rotterdam, Netherlands; Balkema (1987). (CONF-870812—). Contract W-31-109-ENG-38.

From 9. SMIRT: international conference on structural mechanics in reactor technology; Lausanne, Switzerland (17 Aug 1987).

Theoretical calculations and experimental measurements of the quantity of retained fission gas in irradiated metallic fuel (U-5 wt. % Fs) are presented. (The symbol 'Fs' designates fissium, a 'pseudo-element' which, in reality, is an alloy whose composition is representative of fission products that remain in reprocessed fuel). The calculations utilize the Booth method to model the steady-state release of gases from fuel grains and a simplified grain-boundary gas model to predict the gas release from intergranular regions. The quantity of gas retained in as-irradiated fuel was determined by collecting the gases released from short segments of EBR-II driver fuel that were melted in a gas-tight furnace. Comparison of the calculations with the measurements shows quantitative agreement in both the magnitude and the axial variation of the retained gas content.

21574 **Cladding failure margins for metallic fuel in the integral fast reactor.** Bauer, T.H.; Fenske, G.R.; Kramer, J.M. (Argonne National Lab., IL, USA). pp 31-38 of Transactions of the 9th international conference on structural mechanics in reactor technology. Vol. C. Fuel elements and assemblies. Wittmann, F.H. (ed.). Rotterdam, Netherlands; Balkema (1987). (CONF-870812—).

From 9. SMIRT: international conference on structural mechanics in reactor technology; Lausanne, Switzerland (17 Aug 1987).

The Integral Fast Reactor (IFR) concept being developed at Argonne National Laboratory has prompted a renewed interest in uranium-based metal alloys as a fuel for sodium-cooled fast reactors. In this paper we will present recent measurements of cladding eutectic penetration rates for the ternary IFR alloy and will compare these results with earlier eutectic penetration data for other fuel and cladding materials. A method for calculating failure of metallic fuel pins is developed by combining cladding deformation equations with a large strain analysis where the hoop stress is calculated using the instantaneous wall thickness as determined from correlations of the eutectic penetration-rate data. This method is applied to analyze the results of in-reactor and out-of-reactor fuel pin failure tests on uranium-fissium alloy EBR-II Mark-II driver fuel. In the final section of this paper we extend the calculations to consider the failure of IFR ternary fuel under reactor accident conditions.

21575 **Cladding failure probability modeling for risk evaluations of fast reactors.** Mueller, C.J.; Kramer, J.M. (Argonne National Lab., IL, USA). pp 39-43 of Transactions of the 9th international conference on structural mechanics in reactor technology. Vol. C. Fuel elements and assemblies. Wittmann, F.H. (ed.). Rotterdam, Netherlands; Balkema (1987). (CONF-870812—). Contract W-31-109-ENG-38.

From 9. SMIRT: international conference on structural mechanics in reactor technology; Lausanne, Switzerland (17 Aug 1987).

This paper develops the methodology to incorporate cladding failure data and associated modeling into risk evaluations of

liquid metal-cooled fast reactors (LMRs). Current U.S. innovative designs for metal-fueled pool-type LMRs take advantage of inherent reactivity feedback mechanisms to limit reactor temperature increases in response to classic anticipated-transient-without-scram (ATWS) initiators. Final shutdown without reliance on engineered safety features can then be accomplished if sufficient time is available for operator intervention to terminate fission power production and/or provide auxiliary cooling prior to significant core disruption. Coherent cladding failure under the sustained elevated temperatures of ATWS events serves as one indicator of core disruption. In this paper we combine uncertainties in cladding failure data with uncertainties in calculations of ATWS cladding temperature conditions to calculate probabilities of cladding failure as a function of the time for accident recovery.

2106 Power Reactors, Auxiliary, Mobile, Package, And Transportable

REFER ALSO TO CITATION(S) 21586

21576 **(CONF-870102—Summs.) Transactions of the fourth symposium on space nuclear power systems.** El-Genk, M.S.; Hoover, M.D. (eds.). (New Mexico Univ., Albuquerque (USA). Inst. for Space Nuclear Power Studies). 1987. Contract AC04-76DP00789;W-7405-ENG-36. 512p. NTIS, PC A22/MF A01; 1; GPO Dep. Order Number DE88006164/JAW.

From 4. symposium on space nuclear power systems; Albuquerque, NM, USA (12 Jan 1987).

This paper contains the presented papers at the fourth symposium on space nuclear power systems. Topics of these papers include: space nuclear missions and applications, reactors and shielding, nuclear electric and nuclear propulsion, refractory alloys and high-temperature materials, instrumentation and control, energy conversion and storage, space nuclear fuels, thermal management, nuclear safety, simulation and modeling, and multimegawatt system concepts. (LSP)

21577 **(CONF-880122—Summs.) Transactions of the fifth symposium on space nuclear power systems.** El-Genk, M.S.; Hoover, M.D. (eds.). (New Mexico Univ., Albuquerque (USA). Inst. for Space Nuclear Power Studies). 1988. Contract AC04-76DP00789;W-7405-ENG-36. 616p. NTIS, PC A99/MF A01; 1; GPO Dep. Order Number DE88006165/JAW.

From 5. symposium on space nuclear power systems; Albuquerque, NM, USA (11 Jan 1988).

This paper contains the presented papers at the fourth symposium on space nuclear power systems. Topics of these paper include: space nuclear missions and applications, reactors and shielding, nuclear electric and nuclear propulsion, high-temperature materials, instrumentation and control, energy conversion and storage, space nuclear fuels, thermal management, nuclear safety, simulation and modeling, and multimegawatt system concepts. (LSP)

21578 **(LA—11071-MS) Compatibility in space reactor fuel systems.** Mason, R.E.; Matthews, R.B. (Los Alamos National Lab., NM (USA)). Mar 1988. Contract W-7405-ENG-36. 38p. NTIS, PC A03/MFA 01; 1; GPO Dep. Order Number DE88005698/JAW.

Isothermal out-of-pile tests for compatibility between Nb-1Zr, tungsten or rhenium, and UN identified high-temperature interactions. These tests demonstrated uranium transport to the inner surface of the cladding and zirconium transport from the cladding to the pellet surface. A URe_2 layer was found on the rhenium barrier of tests performed at 1800 K. No other reactions between UN and rhenium were observed. Interdiffusion of rhenium and tungsten with Nb-1Zr was consistent with rates reported in the literature. Significant cladding grain growth was observed in specimens tested at or above 1600 K. One compatibility pin was heated until the cladding melted and the pin was breached. The pin components began melting below the melting point of Nb-1Zr. The cladding and end caps were first to melt; then the liquid partially dissolved the tungsten in barrier and disks and the UN from the surface of the pellet. 6 refs., 20 figs., 9 tabs.

21579 **(N—88-14054) Small space reactor power systems for unmanned solar system exploration missions.** Bloomfield, H.S. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Dec 1987. 117p. (NASA-TM—100228; E—3847; NAS—1.15:100228). NTIS, PC A06/MF A01.

A preliminary feasibility study of the application of small nuclear reactor space power systems to the Mariner Mark II Cassini spacecraft/mission was conducted. The purpose of the study was to identify and assess the technology and performance issues associated with the reactor power system/spacecraft/mission integration. The Cassini mission was selected because study of the Saturn system was identified as a high priority outer planet exploration objective. Reactor power systems applied to this mission were evaluated for two different uses. First, a very small 1 kWe reactor power system was used as an RTG replacement for the nominal spacecraft mission science payload power requirements while still retaining the spacecraft's usual bipropellant chemical propulsion system. The second use of reactor power involved the additional replacement of the chemical propulsion system with a small reactor power system and an electric propulsion system. The study also provides an examination of potential applications for the additional power available for scientific data collection. The reactor power system characteristics utilized in the study were based on a parametric mass model that was developed specifically for these low power applications. The model was generated following a neutronic safety and operational feasibility assessment of six small reactor concepts solicited from U.S. industry. This assessment provided the validation of reactor safety for all mission phases and generatad the reactor mass and dimensional data needed for the system mass model.

21580 **(PNL—6458) Fabric space radiators.** Antoniak, Z.I.; Krotiuk, W.J.; Webb, B.J.; Prater, J.T.; Bates, J.M. (Pacific Northwest Lab., Richland, WA (USA)). Jan 1988. Contract AC06-76RL01830. 79p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88005569/JAW.

Future Air Force space missions will require thermal radiators that both survive in the hostile space environment and stow away for minimal bulk during launch. Advances in all aspects of radiator design, construction, and analysis will be necessary to enable such future missions. Currently, the best means for obtaining high strength along with flexibility is through structures known as fabrics. The development of new materials and bonding techniques has extended the application range of fabrics into areas traditionally dominated by monolithic and/or metallic structures. Given that even current spacecraft heat rejection considerations tend to dominate spacecraft design and mass, the larger and more complex designs of the future face daunting challenges in thermal control. Ceramic fabrics bonded to ultra-thin metal liners (foils) have the potential of achieving radiator performance levels heretofore unattainable, and of readily matching the advances made in other branches of spacecraft design. The research effort documented here indicates that both pumped loops and heat pipes constructed in ceramic fabrics stand to benefit in multiple ways. Flexibility and low mass are the main advantages exhibited by fabric radiators over conventional metal ones. We feel that fabric radiators have intrinsic merits not possessed by any other radiator design and need to be researched further. 26 refs., 16 figs., 17 tabs.

21581 **(PNL-SA—15107) Molybdenum-base cermet fuel development.** Gurwell, W.E.; Moss, R.W.; Pilger, J.P.; White, G.D. (Pacific Northwest Lab., Richland, WA (USA)). Jul 1987. Contract AC06-76RL01830. 7p. (CONF-880122—7). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005529/JAW.

From 5. symposium on space nuclear power systems; Albuquerque, NM, USA (11 Jan 1988).

Development of a multimegawatt (MMW) space nuclear power system requires identification and resolution of several technical feasibility issues before selecting one or more promising system concepts. Demonstration of reactor fuel fabrication technology is required for cermet-fueled reactor concepts. MMW reactor fuel development activity at Pacific Northwest Laboratory (PNL) is focused on producing a molybdenum-matrix uranium-nitride (UN) fueled cermet. This cermet is to have a high matrix density (≧95%) for high strength and high thermal conductance coupled

with a high particle (UN) porosity (~25%) for retention of released fission gas at high burnup. Fabrication process development involves the use of porous TiN microspheres as surrogate fuel material until porous UN microspheres become available. Process development has been conducted in the areas of microsphere synthesis, particle sealing/coating, and high-energy-rate forming (HERF) and vacuum hot press consolidation techniques. This paper summarizes the status of these activities.

21582 **(PNL-SA—15224) Cermet-fueled reactors for advanced space applications.** Cowan, C.L.; Palmer, R.S.; Taylor, I.N.; Vaidyanathan, S.; Bhattacharyya, S.K.; Barner, J.O. (General Electric Co., San Jose, CA (USA). Astro Space Div.; Argonne National Lab., IL (USA); Pacific Northwest Lab., Richland, WA (USA)). Dec 1987. Contract AC06-76RL01830. 7p. (CONF-880122—8). NTIS, PC A02. Order Number DE88005528/JAW.

From 5. symposium on space nuclear power systems; Albuquerque, NM, USA (11 Jan 1988).

Cermet-fueled nuclear reactors are attractive candidates for high-performance advanced space power systems. The cermet consists of a hexagonal matrix of a refractory metal and a ceramic fuel, with multiple tubular flow channels. The high performance characteristics of the fuel matrix come from its high strength at elevated temperatures and its high thermal conductivity. The cermet fuel concept evolved in the 1960s with the objective of developing a reactor design that could be used for a wide range of mobile power generating sytems, including both Brayton and Rankine power conversion cycles. High temperature thermal cycling tests for the cermet fuel were carried out by General Electric as part of the 710 Project (General Electric 1966), and by Argonne National Laboratory in the Direct Nuclear Rocket Program (1965). Development programs for cermet fuel are currently under way at Argonne National Laboratory and Pacific Northwest Laboratory. The high temperature qualification tests from the 1960s have provided a base for the incorporation of cermet fuel in advanced space applications. The status of the cermet fuel development activities and descriptions of the key features of the cermet-fueled reactor design are summarized in this paper.

2107 Regulation And Licensing

REFER ALSO TO CITATION(S) 21124, 21130, 21131, 21608, 21645

21583 **(NUREG—0040-Vol.11-No.4) Licensee contractor and vendor inspection status report: Quarterly report, October 1987-December 1987.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Reactor Inspection and Safeguards). Feb 1988. 182p. NTIS, PC A09/MF A01 - GPO. Order Number TI88900457/JAW.

This periodical covers the results of inspections performed by the NRC's Vendor Inspection Branch that have been distributed to the inspected organizations during the period from October 1987 thru December 1987. Also, included in this issue are the results of certain inspections performed prior to October 1987 that were not included in previous issues of NUREG-0040.

21584 **(NUREG—0540-Vol.9-No.11) Title list of documents made publicly available, November 1-30, 1987.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Publications Services). Jan 1988. 314p. NTIS, PC A14/MF A01 - GPO. Order Number TI88900442/JAW.

This is a monthly publication. It contains descriptions of the information received and generated by the US Nuclear Regulatory Commission (NRC). This information includes (1) docketed material associated with civilian nuclear power plants and other uses of radioactive materials and (2) nondocketed material received and generated by NRC pertinent to its role as a regulatory agency. As used here, docketed does not refer to Court dockets; it refers to the system by which NRC maintains its regulatory records. This series of documents is indexed by a Personal Author Index, a Corporate Source Index, and a Report Number Index.

21585 **(NUREG—0750-Vol.26-No.3) Nuclear Regulatory Commission issuances, September 1987.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Publications Services). Sep 1987. 153p. NTIS, PC A08/MF A01 - GPO. Order Number TI88900446/JAW.

This report includes the issuances received during the specified period from the Commission (CLI), the Atomic Safety and Licensing Appeal Boards (ALAB), the Atomic Safety and Licensing Boards (LBP), the Administrative Law Judge (ALJ), the Directors' Decisions (DD), and the Denials of Petitions for Rulemaking (DPRM).

2108 Economics

REFER ALSO TO CITATION(S) 21809, 21810, 21811, 21812, 21813, 21814

22 NUCLEAR REACTOR TECHNOLOGY

REFER ALSO TO CITATION(S) 21535, 22239

2201 Theory And Calculation

REFER ALSO TO CITATION(S) 21619, 21652, 23725

21586 **(DOE/ER/75172—6) Proceedings of the 24th annual American Nuclear Society: Midwest student conference.** (American Nuclear Society, La Grange Park, IL). 1987. Contract FG02-85ER75172. 69p. (CONF-8703245—Summs.). NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88005042/JAW.

From 24. annual American Nuclear Society midwest student conference - nuclear technology: perceptions vs. reality; College Station, TX, USA (26 Mar 1987).

This document is a program given to participants at a conference stressing student research. Containing only abstracts, the document includes topics such as computer applications, space power, thermal hydraulics, radiation theory and technology, reactor theory, public relations, and public information. (TEM)

21587 **(EGG-M—38987) A report on the study of algorithms to enhance Vector computer performance for the discretized one-dimensional time-dependent heat conduction equation: EPIC research, Phase 1.** Majumdar, A.; Makowitz, H. (Idaho State Univ., Pocatello (USA). Coll. of Engineering; EG and G Idaho, Inc., Idaho Falls (USA)). Oct 1987. Contract AC07-76ID01570. 40p. (CONF-871101—81). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005642/JAW.

From Joint meeting of the American Nuclear Society and the Atomic Industrial Forum; Los Angeles, CA, USA (15 Nov 1987).

With the development of modern vector/parallel supercomputers and their lower performance clones it has become possible to increase computational performance by several orders of magnitude when comparing to the previous generation of scalar computers. These performance gains are not observed when production versions of current thermal-hydraulic codes are implemented on modern supercomputers. It is our belief that this is due in part to the inappropriateness of using old thermal-hydraulic algorithms with these new computer architectures. We believe that a new generation of algorithms needs to be developed for thermal-hydraulics simulation that is optimized for vector/parallel architectures, and not the scalar computers of the previous generation. We have begun a study that will investigate several approaches for designing such optimal algorithms. These approaches are based on the following concepts: minimize recursion; utilize predictor-corrector iterative methods; maximize the convergence rate of iterative methods used; use physical approximations as well as numerical means to accelerate convergence; utilize explicit methods (i.e., marching) where stability will permit. We call this approach the "EPIC" methodology (i.e., Explicit Predictor Iterative Corrector methods). Utilizing the above ideas, we have begun our work by investigating the one-dimensional transient heat conduction equation. We have

developed several algorithms based on variations of the Hopscotch concept, which we discuss in the body of this report. 14 refs.

21588 (FEI—1788) Neutron microscopic library in the system of constant provisions for the RZA program complex. Vasil'chenko, G.A.; Dekusar, V.M.; Kalashnikov, A.G.; Kislitsyna, T.S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1986. 11p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701012/JAW.

Library in the system of constant provision for the RZA program complex of two-dimensional reactor calculation, taking account of the fuel burnup and neutron thermalization, is described. The library comprises 21-group systems of neutron-physical microconstants in the slowing-down range and two 17-group systems in the thermalization range, built according to the principle of one group - all elements. The described library is realized at the BESM-6 computer and may be also used in other programs for calculation of reactors and shielding. 10 refs.

21589 (NEANDC-U—242) Nuclear Energy Agency Nuclear Data Committee summary record of the twenty-sixth meeting (technical sessions), Rome, Italy. Young, P.G. (comp.). (Nuclear Energy Agency, 75 - Paris (France). Nuclear Data Committee; Los Alamos National Lab., NM (USA)). 1987. 59p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88900396/JAW.

This volume provides a brief synopsis of Nuclear Energy Agency Nuclear Data Committee members' activities. (JDH)

21590 (NIIAR—21(667)) Modules of the NF-6 code for calculation of perturbation-theory integrals and reactivity coefficient space behaviour in two-dimensional geometry. Alekseev, P.N.; Bikineeva, S.A. (Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike, Moscow (USSR)). 1985. 22p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703013/JAW.

Modules permitting to conduct multigroup diffusion finite-difference calculation of integrals in the perturbation theory and reactivity in the nodes of the calculation grid for two-dimensional xy and RZ geometry are described. Direct calculations are compared with the calculations by the perturbation theory. The modules are written in the Algol-GDR language for the BESM-6 computer and connected in the NF-6 complex for calculation of the main neutron-physical pertormance of nuclear reactors. The calculations are carried out for the BOR-60 reactor. 9 references, 2 figures, 3 tables.

21591 (NIIAR—26(707)) Technique for calculation of radiation energy release in nuclear reactors. Povarov, V.P.; Polivanov, I.F.; Tereshchenko, A.B. (Nauchno-Issledovatel'skij Inst. Atomnykh Reaktorov, Dimitrovgrad (USSR)). 1986. 20p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703014/JAW.

A technique for calculation of radiation energy deposition in nuclear reactor materials taking into account gamma quanta production in capture and inelastic scattering is described. The calculated data are compared with the experimental data in radiation energy deposition in the organic coolant of the WR-1 reactor. The calculated results for radiation energy deposition in the organic coolant-moderator of the district heating nuclear plant ARBUS reactor are given as an example to illustrate the technique application. 16 references, 2 figures, 5 tables.

2202 Components And Accessories

REFER ALSO TO CITATION(S) 21617, 21627, 21631, 21637, 21638, 21639, 21640, 21642, 21650, 21652, 21655, 21656, 21657, 21662, 21663, 21665, 22309

21592 (CONF-870863—5) Numerical simulation of a 1/6-scale concrete containment model. Pfeiffer, P.A.; Kulak, R.F.; Kennedy, J.M.; Marchertas, A.H.; Fiala, C. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005925/JAW.

From Seminar on small and medium-sized nuclear reactors: safety and licensing issues; Lausanne, Switzerland (24 Aug 1987).

Prediction of the response of the Sandia National Laboratories 1/6-scale reinforced concrete containment model test was prepared by the Engineering Mechanics Program of Argonne National Laboratory. The two-dimensional code TEMP-STRESS and the three-dimensional NEPTUNE code was utilized in the present study to predict the global response of the structure, to identify global failure sites and their corresponding failure pressures, and to identify some local failure sites and their pressure levels. An axisymmetric model was studied with the program TEMP-STRESS and a three-dimensional circumferential segment model with the program NEPTUNE. These models are used to predict various failure mechanisms, such as hoop failure of the vessel at midheight following failure of a splice in this area and failure of a weld in the liner near the basemat due to excessive strains. In reality, simultaneous failure in more than one mechanism is unlikely since the onset of failure in any one mechanism will reduce the pressure and therefore reduce the stress on other possible sites of failure. The analytical approaches in TEMP-STRESS and NEPTUNE are similar. Both codes use explicit temporal integration for dynamic problems and dynamic relaxation for static problems. This enables the codes to be used for static as well as dynamic problems. The choice of the integration scheme was primarily dictated by the high nonlinear concrete behavior and the relative ease of accounting for nonlinearity in this type of algorithm. At each load step, equilibrium is obtained when a force and displacement criteria are satisfied. 7 refs., 4 figs.

21593 (CONF-880424—6) The development of an intelligent nuclear maintenance robot. Mann, R.C.; Hamel, W.R.; Weisbin, C.R. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005439/JAW.

From IEEE international conference on robotics and automation; Philadelphia, PA, USA (25 Apr 1988).

The US Department of Energy has provided support to four universities and the Oak Ridge National Laboratory (ORNL) in order to pursue research leading to the development and deployment of robotic system(s) for advanced nuclear power stations. This paper describes the scope of the program and the R and D effort contributed by ORNL. 9 refs.

21594 (DOE/OR/21400—T333) Nuclear reactor pressure vessel integrity. Robinson, G.C. (Oak Ridge National Lab., TN (USA)). 31 Mar 1988. Contract AC05-84OR21400. 42p. NTIS, PC A03. Order Number DE88005845/JAW.

Viewgraphs are presented which provide information on the structural integrity of reactor pressure vessels. (JDB)

21595 (GKSS—86/E/66) Development of a European Group on Fracture procedure to measure elastic-plastic fracture parameters. Schwalbe, K.H.; Neale, B.K.; Ingham, T. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.); Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). 1986. 26p. (CONF-8606382—). GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude, Germany, F.R.

From 6. European conference on fracture (ECF-6); Amsterdam, Netherlands (15 Jun 1986).

Recent progress in elastic-plastic fracture mechanics and experience with existing test standards has prompted the European Group on Fracture (EGF) to form a working party aimed at writing an elastic-plastic fracture mechanics testing procedure which is based on European experience and European views. The present status of the working party procedure is described together with a brief description of existing methods.

21596 (NUREG/CR—4784) Influence of ground water on soil-structure interaction. Costantino, C.J.; Philippacopoulos, A.J. (City Univ. of New York, NY (USA); Brookhaven National Lab., Upton, NY (USA)). Dec 1987. Contract AC02-76CH00016. 64p. (BNL-NUREG—52039). NTIS, PC A04/MF A01. Order Number TI88006086/JAW.

This report presents a summary of the second year's effort on the subject of the influence of foundation ground water on the SSI phenomenon. A finite element computer program, developed during the first year's effort, was used to study the impact of depth to the ground water surface on the SSI problem. The formulation used therein is based on the Biot dynamic equations of motion for both the solid and fluid phases of a typical soil. Frequency dependent interaction coefficients were then generated for the two-dimensional plane problem of a rigid surface footing moving against a linear soil. The soil is considered dry above the GWT and fully saturated below. The results indicate that interaction coefficients are significantly modified as compared to the comparable values for a dry soil, particularly for the rocking mode of response, if the GWT is close to the foundation. As the GWT moves away from the foundation, these effects decrease in a relatively orderly fashion for both the horizontal and rocking modes of response. For the vertical interaction coefficients, the rate of convergence to the dry solution is frequency dependent. Calculations were made to study the impact of the modified interaction coefficients on the response of a typical nuclear reactor building. The amplification factors for a stick model placed atop a dry and saturated soil were computed. It was found that pore water caused the rocking response to decrease and translational response to increase over the frequency range of interest, as compared to the response on dry soil. 30 refs., 31 figs.

21597 **(SAND—87-2474) Predicting turbine generator performance.** Padgett, P.O.; DeBey, T.M. (Sandia National Labs., Albuquerque, NM (USA)). Jan 1988. 90p. NTIS, PC A05/MF A01. Order Number DE88006585/JAW.

The US Department of Energy's Nuclear Plant Lifetime Improvement Program is investigating the use of prognostic monitoring for improving equipment performance. This paper describes the investigation of performance prediction on steam-turbine generators, with a steam-turbine generator at the N-reactor being the specific unit of interest. Equipment degradation, failure modes, and monitoring techniques are described. 13 refs., 5 figs., 7 tabs.

21598 **(SAND—88-0293C) Cable condition monitoring research activities at Sandia National Laboratories.** Jacobus, M.J.; Zigler, G.L.; Bustard, L.D. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 9p. (CONF-880240—1). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88005615/JAW.

From EPRI cable condition monitoring workshop; San Francisco, CA, USA (16 Feb 1988).

Sandia National Laboratories is currently conducting long-term aging research on representative samples of nuclear power plant cables. The objectives of the program are to determine the suitability of these cables for extended life (beyond 40 year design basis) and to assess various cable condition monitoring techniques for predicting remaining cable life. The cables are being aged for long times at relatively mild exposure conditions with various condition monitoring techniques to be employed during the aging process. Following the aging process, the cables will be exposed to a sequential accident profile consisting of high dose rate irradiation followed by a simulated design basis loss-of-coolant accident (LOCA) steam exposure. 12 refs., 1 fig., 1 tab.

21599 **Construction of a 1/6-scale concrete containment model.** Horschel, D.S. (Sandia National Labs., Albuquerque, NM, USA). *Nuclear Engineering and Design;* **104**: No. 3, 341-347(Nov 1987). (CONF-860507—). Contract AC04-76DP00789.

From 3. workshop on integrity of containments for nuclear power plants; Washington, DC, USA (21 May 1986).

This paper discusses the features and construction of a 1/6-scale reinforced-concrete containment model that has been built at Sandia National Laboratories in Albuquerque, New Mexico. The model Light-Water-Reactor (LWR) containment building was designed and built to the American Society of Mechanical Engineers (ASME) code by United Engineers and Constructors, Inc. The containment model will be tested to failure to determine its response to static internal overpressurization. The results from testing the heavily instrumented containment will be used to assess the capability of analytical methods for predicting the performance of containments subject to severe accident loads as part of the US Nuclear Regulatory Commission's program on containment integrity. The scaled dimensions of the cylindrical wall and hemispherical dome are typical of a full-size containment. Features representative of a prototypical containment and included in the heavily reinforced model are equipment hatches, personnel airlocks, several small piping penetrations, and a thin steel liner attached to the concrete by headed studs.

21600 **Current status of the WHAMS-3D code.** Kennedy, J.M.; Belytschko, T. (Argonne National Lab., IL, USA. Reactor Analysis and Safety Div.; Northwestern Univ., Evanston, IL, USA. Dept. of Civil Engineering). pp 353-358 of Transactions of the 9th international conference on structural mechanics in reactor technology. Vol. B. Computational mechanics and computer-aided engineering. Wittmann, F.H. (ed.). Rotterdam, Netherlands; Balkema (1987). (CONF-870812—).

From 9. SMIRT: international conference on structural mechanics in reactor technology; Lausanne, Switzerland (17 Aug 1987).

The program WHAMS-3D is an explicit time integration program which employs a finite element format, so that it possesses considerable versatility in modeling complex shapes and boundary conditions. The element library consists of the following: Quadrilateral and triangular plate-shell elements, a beam element, a spring element and a hexahedral continuum element. In addition, a rigid linkage is included which permits the efficient modeling of very stiff portions of a structure, such as the bottom ring of a core barrel. In a rigid linkage, the motion of a master node defines the motion of all slave nodes linked to the master node. This option is also useful for eccentrically connected elements where the midlines of the connected elements do not coincide, as for example, in stiffeners. Time integration is performed by the central difference method. The mass matrix is diagonal (lumped), so no equations need be solved. Different time steps can be used in different parts of the mesh.

2203 Fuel Elements

REFER ALSO TO CITATION(S) 21629

21601 **(BMU—1987-169) Bursting of Zircaloy cladding stressed by internal pressure. An evaluation of experimental supported mathematical models.** Keusenhoff, J. (Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany, F.R.); Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). 1987. 78p. (In German). (GRS-A—1232). GRM Werbeberatung - Werbemittlung - PR, Eggenstein-Leopoldshafen,, Germany, F.R.

Schriftenreihe Reaktorsicherheit und Strahlenschutz. Ergebnisberichte, Untersuchungen, Studien, Gutachten.

The mechanical behaviour of Zircaloy cladding stressed by internal pressure will be described by empirically found equations for creep velocity, burst stress and oxidation. By systematic investigations the influence of the main input parameters will be shown in simple diagrams. All the relations are explicit. The influence of azimuthal temperature differences is described by a special model.

21602 **(CEA-CONF—9047) Irradiation devices for experiences on power ramps and cyclings at the CEA/DERPE.** Friboulet, C.; Roche, M. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Inst. de Recherche Technologique et de Developpement Industriel (IRDI)). May 1987. 31p. (In French). (CONF-8705237—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752130/JAW.

From IAEA technical committee meeting on power ramping cycling and load following behaviour of water reactor fuel; Lyon, France (18 May 1987).

In this paper the authors describe briefly the irradiation devices used by the CEA/DERPE. These irradiation devices are of two types: irradiation specimen capsule (AQUILON, BOSS, GRIFFON), water loop (ISABELLE 1, JET-POMPE, ISABELLE 4, IRENE, OPERA) in which the conditions are those of PWR Reactor. They are implanted in the OSIRIS and SILOE reactors with a thermal neutron flux of 2.5 10/sup 14/ n/cm/sup 2/.s. In the pool

reactor non destructive tests can be made on pin fuels to give valuable informations on their behaviour under power ramps and cyclings.

21603 **(FEI—1829) Srudying the critical power of the lower fuel assembly in the RBMK-1500 cluster.** Gorban', L.M.; Dmitriev, A.M.; Nikolaev, V.A.; Pomet'ko, R.S.; Perepelitsa, N.I.; Ryabov, A.N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1987. 15p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701568/JAW.

Results of experimental and calculational investigations of critical heat transfer in assemblies of the RBMK-1500 cluster are considered. Possibility of freon use when simulating critical heat transfer for assemblies of the given geometry is shown. Applicability of Macbeth and Osmachkin formula (modifications for the RBMK geometry) at uniform heat release by length for short assemblies, as well as technique provided for the plant design at uniform and nonuniform heat release by ecngth is being analyzed.

21604 **(FEI—1840) Calculating the strength properties of fuel elements and hexagonal fuel assembly channel taking into account the simultaneous deformation of the fuel element cluster and channel under irradiation in a fast reactor core.** Kravchenko, I.N.; Bagdasarov, Yu.E.; Likhachev, Yu.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1987. 22p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701730/JAW.

Method for determining stressed-strained state of fuel cans and hexagonal fuel assembly shroud under their simultaneous deformation in a fast reactor core is presented. Mathematical formulation of thee-dimensional problem of determining equilibrium fuel element configuration in a fuel assembly is given. The solution of the problem is inportant both for strength and thermal-hydraulic analysis. Descriptions of algorithms, computing program complex and results of test calculations are presented. The developed technique and program complex enable to determine fuel element displacement inside fuel assembly and contact forces among adjoining fuel elements, corresponding to equilibrium, configuration of fuel element cluster in hexagonal fuel assembly shroud; geometric characteristics of equilibrium configuration of fuel element cluster (squares of flow sections for the coolant), necessary for thermal-hydraulic calculation of fuel assembly; stressed-strained state of fuel assembly elements (fuel cans spacing wire, shroud) under simultaneous deformation of the shroud and fuel element cluster. 8 refs.

2204 Control Systems

REFER ALSO TO CITATION(S) 21629, 21673

21605 **(CEA-DRNR-P—355) Parametric experiments on control rod heterogeneity in the framework of the Balzac program.** Kim, Y.C.; Palmiotti, G.; Salvatores, M.; Soule, R. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France). Dept. des Reacteurs a Neutrons Rapides). Sep 1986. 12p. (CONF-8609385—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88752123/JAW.

From 29. reunion NEACRP; Ontario, Canada (22 Sep 1986).

The calculation of the so-called heterogeneity effect of control rod reactivity worth, is still to be considered one of the major source of uncertainty in assessing a power reactor control rod worth. The reason for the uncertainty is related both to the fact that at present no specific calculation tool can handle with sufficient precision this effect and that there is limited experimental validation of the approximate available methods. The present note will briefly recall the nature of the problem and its implications, in particular in the framework of the Super Phenix start-up experiments, and will indicate an experimental program on Masurca, aimed to a systematic study of the heterogeneity effect, in the frame of the Balzac program.

21606 **(EGG-M—18787) Techniques for incorporating operator expertise into intelligent decision aids and training.** Blackman, H.S.; Nelson, W.R. (EG and G Idaho, Inc., Idaho Falls (USA)). 1987. Contract AC07-76ID01570. 15p. (CONF-870818—2). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005057/JAW.

From International post-SMIRT seminar on accident sequence modelling: human actions, system response, intelligent decision aids; Munich, F.R. Germany (24 Aug 1987).

The objective of this work is to evaluate the potential for developing a complete model for training novices based upon a combination of rules for operation, and heuristics for application of the rules. The method used to investigate this potential is based upon the experimental evaluation of the response tree expert system. The present study used the low pressure injection system (LPIS) simulation developed for the response tree expert system evaluation, so that the rules of operation were already developed, and only the expert heuristics needed to be identified. The heuristics were abstracted from concurrent and recall protocols, taken from expert operators while attempting to solve transients on the LPIS, using protocol analysis techniques previously developed. This paper describes the experiment, and identifies the mental processes used by expert operators.

21607 **(EPRI-NP—5537) Remote calibration of Resistance Temperature Devices (RTDs): Final report.** Blalock, T.V.; Roberts, M.J. (Oak Ridge National Lab., TN (USA)). Feb 1988. Contract AC05-84OR21400. 265p. NTIS, PC A12/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303; 1; GPO Dep. Order Number DE88006381/JAW.

Johnson noise power measuring techniques have been used to calibrate platinum resistance temperature detectors (RTDs) installed in an operating nuclear plant - Connecticut Yankee Atomic Power Company's Haddam Neck Nuclear Plant - achieving agreement with the dc calibration from better than 0.1% to as much as 1% (0.54 to 9.7°F) at the normal operating temperature of 585°F. Tests were also conducted at plant shutdown conditions. In this application, RTDs with an ice point resistance of 200 Ω were connected with four-wire extension cables approximately 100-ft long to a test station in containment. Methods were developed for in situ characterization of the extension cables and for quantitative measurement of and correction for nonthermal induced noise. Analysis of dc calibration methods showed that resistance-temperature tables used with industrial PRTs may be in error by 0.2°F or 0.02% A (expressed as a percentage of absolute temperature in either Kelvin or degrees Rankine) at 540°F. Recalibration of the RTDs measured in the plant tests showed differences of about 2.5°F or 0.2% A at 540°F from calibration tables used in the plant.

21608 **(EPRI-NP—5618) Enhancing plant effectiveness through improved organizational communication: Final report.** Bauman, M.B.; Van Cott, H.P. (Essex Corp., Alexandria, VA (USA)). Feb 1988. 233p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920196/JAW.

This EPRI-sponsored study reviewed the organizational communications used by nuclear power plants (NPPs) and identified weak links in the chain of coordination and information processing required to effectively perform corrective and preventive maintenance in the plants. Survey results from four NPPs showed that special attention would have to be given to many communication areas to improve the work control process and decrease the time delays involved in the performance of maintenance work. This study evaluated two interventions designed to improve the effectiveness of the work control process. One involved using an automated maintenance management system as a way of improving interdepartmental communication as it relates to the implementation of maintenance work orders. Another intervention consisted of interdepartmental meetings for supervisors as a method for improving organizational communication. The effectiveness of these interventions was evaluated, and the findings were used to identify functional requirement guidelines for an automated maintenance management system. 31 refs., 20 figs., 13 tabs.

21609 **(PINSTECH—108) Development of reactor core surveillance system for PARR.** Ansari, S.A.; Ayazuddin, S.K. (Pakistan Inst. of Nuclear Science and Technology, Rawalpindi. Nuclear Engineering Div.). Dec 1984. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701215/JAW.

A computer based surveillance system has been developed at PARR for an early detection and identification of any core abnormality. The system acquires various plant signals monitoring the reactor core condition and performs the frequency analysis of the fluctuations in these signals. It calculates the root mean square values of signal fluctuations, the signal power as a function of frequency or power spectral density and the auto and cross correlation functions. The system has already been used at PARR for the detection of control rod vibration in the reactor. In this report the system application for determining the dynamic performance of locally fabricated reflector elements in the core is described. (orig./A.B.). 6 figs., 5 refs.

2205 Environmental Aspects

REFER ALSO TO CITATION(S) 21553, 21624, 21634, 22818, 23073

21610 **(ENEA-RT-DISP—85-3) Healt protection aspects of Tritium control in nuclear facilities.** De Blasiis, M. (ENEA, Rome (Italy)). 1985. 71p. (In Italian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88700986/JAW.

In this report the problems of the Tritium in nuclear facilities are presented and discussed from radiological point of view.

21611 **(ENEA-RT-PAS—85-26) Air concentration and ground deposition following radioactive airborne releases.** Brofferio, C.; Cagnetti, P.; Ferrara, V. (ENEA, Rome (Italy)). 1985. 101p. (In Italian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88700991/JAW.

The fundamental aim of this report is to provide the mathematical and physical operational basis for the evaluation of air concentration and ground deposition, following radioactive airborne releases from a nuclear power plant, both during normal operations and in accidental conditions. As far as accidental releases are concerned, the basical assumptions on meteorological and diffusive situation are considered from a safety point of view: namely those pessimistic but realistically representative situation are taken into account which lead to maximum air concentration and ground deposition values, even if characterized by low recurrence probability. Those elements are the inputs for many environmental transfer models of maximum consequence evaluations up to man. As far as routine releases are concerned, it is shown, together with the usual models based on long term averaged meteorological conditions, also models studied to estimate atmospheric diffusion and deposition in low wind situations and in fog conditions, being those latter very frequent in the Po valley. Finally, the main operations and modalities of collecting and elaborating meteorological data for for radioprotection evaluations are also shown. It is to be pointed out that the methods and the models developed and considered in this work are of a more general validity, and can be also used for applications concerning non-radioactive releases, as it is the case when dealing with conventional power plants. 16 refs; 13 fig.

21612 (INIS-mf—10580-Vol.1, pp 37-43) **Automated environment monitoring systems for NPPs.** Deme, Sh.; Fekher, J. 1983. (In Russian). NTIS (US Sales Only), PC A07/MF A01. Order Number DE87780112/JAW. (CONF-8205317—Vol.1).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

Objectives and tasks for a NPP automated environment monitoring system are defined. A structure of the system is suggested and its component functions determined. Transducers for monitoring radioactive releases into atmosphere and water are described as well as those for radionuclides distribution in atmosphere and radiation conditions near NPP. The system cost is about 0.1% from the total NPP cost. 2 figs.

21613 (INIS-mf—10846, pp 55) **Environmental radioactivity in the region of Kozloduj NPP.** Petkov, T.; Kerteva, A.; Badulin, V.; Novakova, E.; Mireva, Z. (Meditsinska Akademiya, Sofia, Bulgaria). Nov 1984. (In Bulgarian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

21614 (INIS-mf—10846, pp 62) **Complex estimation of the radiation effect of the main industrial energy sources.** Stoilova, S. (Meditsinska Akademiya, Sofia, Bulgaria). Nov 1984. (In Bulgarian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

21615 **(JAERI-M—86-166) Study on the aseismic safety of the experimental VHTR on the dense sandy layer.** Fujita, S.; Ito, Y.; Baba, O.; Suzuki, H.; Takewaki, N.; Kondo, T.; Yoshimura, T.; Yamada, H. (Japan Atomic Energy Research Inst., Tokyo). Dec 1986. 243p. (In Japanese). NTIS (US Sales Only), PC A11/MF A01. Order Number DE87702955/JAW.

A series of studies was carried out in 1983 and 1985 for the purpose of confirming the aseismic safety of the Experimental VHTR on the dense sandy layer. In 1983, effect of some of soil properties on seismic responses of the reactor building was estimated by means of a parametric survey, and soil properties were estimated by analyzing the observed earthquake record. In 1985, literature review, linear, nonlinear parametric analyses and nonlinear simulation analyses were carried to study and compare the analysis method. In addition, seismic response of proposed construction site was estimated with nonlinear analysis method. As a result of these studies, the seismic response of reactor building on the dense sandy layers and wave propagation characteristics of sandy layers are understood. Especially, by means of many parametric studies, the effect of input wave characteristics, soil stiffness, nonlinear characteristics of soil properties, and nonlinear analysis method on the reactor building responses were evaluated.

21616 **(NAGRA-NTB—84-34) Core borehole Beznau.** (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Oct 1984. 111p. (In German). Nagra, CH-5401 Baden, Switzerland.

On the occasion of a review of safety aspects related to possible earthquake occurences in the area of the two nuclear power reactors at Beznau, several shallow boreholes were drilled on behalf of Nordostschweizerische Kraftwerke AG on Beznau island in the river Aare during the winter 1979/80. One of the borings located approx. 75 m NNE of reactor building II was cored over its total length and taken to a greater depth of 321,8 m. Because this well offered a good opportunity to gather important results for the research programme of Nagra in northern Switzerland, it was investigated in a very comprehensive way with sedimentological, mineralogical, and geochemical methods and with geophysical, rock-mechanical, hydrogeological, and radioisotope techniques. This is the first deeper borehole drilled in Switzerland that has been evaluated to such a great extent. Below a 20,3-m thick layer of Quaternary deposits, 301,5 m of an almost horizontal sedimentary series of the Tabular Jura was penetrated. The whole interval can be subdivided into 6 distinct types of lithological facies. The clay content of the formation increases with depth. This is demonstrated, on the one hand, by decreases in rock density, quartz content, and microporosity and, on the other hand, by increasing values for specific surface and Al_2O_3 content. The organic carbon content also shows a linear increase with depth.

21617 **Integrated analysis of core debris interactions and their effects on containment integrity using the CONTAIN computer code.** Carroll, D.E.; Bergeron, K.D.; Williams, D.C.; Tills, J.L.; Valdez, G.D. (Sandia National Labs., Albuquerque, NM, USA; Tills, Jack and Associates, Inc., Albuquerque, NM, USA; Technadyne, Albuquerque, NM, USA). *Nuclear Engineering and Design;* **104**: No. 3, 277-283(Nov 1987). (CONF-860507—). Contract AC04-76DP00789.

From 3. workshop on integrity of containments for nuclear power plants; Washington, DC, USA (21 May 1986).

The CONTAIN computer code includes a versatile system of phenomenological models for analyzing the physical, chemical and radiological conditions inside the containment building during severe reactor accidents. Important contributors to these conditions are the interactions which may occur between released corium and cavity concrete. The phenomena associated with interactions between ejected corium debris and the containment atmosphere (Direct Containment Heating or DCH) also pose a potential threat to containment integrity. In this paper, we describe recent enhancements of the CONTAIN code which allow an integrated analysis of these effects in the presence of other mitigating or aggravating physical processes. In particular, the recent inclusion of the CORCON and VANESA models is described and a calculation example presented. With this capability CONTAIN can model core-concrete interactions occurring simultaneously in multiple compartments and can couple the aerosols thereby generated to the mechanistic description of all atmospheric aerosol components. Also discussed are some recent results of modeling the phenomena involved in Direct Containment Heating.

2206 Research, Test, And Experimental Reactors

REFER ALSO TO CITATION(S) 21557, 21609, 21615, 21628, 21635

21618 **(INIS-BR—914) Natural convection in annular duct forming thermosyphon.** Moeller, S.V.; Silva Neto, A.J. da. (Associacao Brasileira de Ciencias Mecanicas, Rio de Janeiro). 1985. 4p. (In Portuguese). (CONF-8512126—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701455/JAW.

From 8. Brazilian Congress of Mechanical Engineering; Sao Jose dos Campos, Brazil (1 Dec 1985).

The experimental study of the heat transfer for water in an annular duct forming a thermosyphon with a large volume tank, determining correlations for the Nusselt Number as a function of Rayleigh Number for three diameter ratios is presented. Furthermore, a simplified mathermatical model for the calculation of the flow rate, obtained by macroscopic balances is also presented.

21619 **(JINR-R—11-86-576) Pulsed-reactor power self-oscillations.** Popov, A.K. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1986. 11p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87702999/JAW.

For analysis of the dynamics of a periodically operating pulsed reactor, the conditions of formation of power self-oscillations are obtained. The oscillations are due to nonlinear dependence of energy in the power pulse on reactivity and power of delayed neutron sources. It is shown that, at reactor mean power achieving the first boundary value, oscillations appear in the reactor with frequency a factor of 2 less than the reactor-power-pulse frequency. For a big value of the mean power, stable oscillations whose amplitude is determined by the mean power level are observed in the reactor. For mean power equal to the secondary boundary value new oscillations appear. The frequency of additional oscillations is less by a factor of 4 than the reactor-power-pulse frequency. The double-frequency oscillations generated are also stable. 7 references, 6 figures, 1 table.

21620 **(NIIAR—12(693)) Device for studies of material radiation creep in the BOR-60 reactor.** Neverov, V.A.; Revyakin, Yu.L. (Nauchno-Issledovatel'skij Inst. Atomnykh Reaktorov, Dimitrovgrad (USSR)). 1986. 30p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE87703011/JAW.

A device for in-pile study of material radiation creep in the BOR-60 reactor core is described. A system for remote detection of tubular specimen deformation is the main part of the device. Primary transformers of the system comprise elements produced of stainless steel and they do not have electric lines. The readings are transmitted by the contactless acoustic method that allows the in-core elements of the system to operate under hard conditions of a fast reactor (flux density up to $2x10^{19}$ m^{-2} s^{-1}, temperature 300-600°C) within the 5-6 m length of circuit. Material creep tests in the device are conducted at stresses up to 580 MPa in the 300-350°C temperature range. Test duration may constitute 2000-4000 h at damaging doses in the material up to 10-15 dpa. 15 references, 9 figures.

21621 **(PINSTECH/HPD—109) Radiation monitoring at Pakistan research reactor.** Ali, A. (Pakistan Inst. of Nuclear Science and Technology, Rawalpindi. Health Physics Div.). May 1984. 6p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701216/JAW.

Area radiation monitoring is accomplished by using Tracer Lab. radiation monitor. Personnel monitoring is carried out using film badges, TLDs (Thermoluminescent Dosimeters) and pocket dosimeters. For the evaluation of monthly accumulated doses of radiation workers film badges/TLDs and for instantaneous/short term dose measurement in higher radiation zones pocket dosimeters are used in addition to film badge/TLD. Environmental monitoring is necessary to check the PARR operation effect on background radiation level in the vicinity of PINSTECH. (A.B.). 4 refs.

21622 **(SAND—87-2357C) Brittle fracture: A concern for metal storage casks.** Emerson, E.L.; Philbin, J.S. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 5p. (CONF-880201—11). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88006106/JAW.

From Waste management '88: symposium on radioactive waste management; Tucson, AZ, USA (26 Feb 1988).

Large ductile cast iron or forged steel storage casks are being considered for use in Independent Spent Fuel Storage Installations or for on-site storage of aged spent fuel. Concern has been expressed over the possibility of brittle-fracture failure occurring in these kinds of casks when subjected to an explosive attack. One of the objectives of safeguards-related experiments performed at Sandia National Laboratories in 1986 was to characterize the failure mechanism of a thick metal wall when subjected to a penetrating high energy device. Test results and conclusions are described in this paper. 4 refs., 1 fig., 1 tab.

21623 (JINR—D-3,4,17-86-747, pp 211-213) **IBR-2 reactor: scientific and methodical news.** Ostanevich, Yu.M. 1987. (In Russian). NTIS (US Sales Only), PC A21/MF A01. Order Number DE88780064/JAW. (CONF-8610176—).

From 5. international school on neutron physics; Alushta, USSR (20 Oct 1986).

A brief description of IBR-2 reactor peculiarities and a list of neutron diffractometers and spectrometers are presented.Results of the most interesting physical experiments are considered. A series of mestable hybrides and a large number of liquid crystal metastable amorphous phases was studied. Investigations into CsHSO/sub 4/-type superion conductors are performed: symmetry of phase with high conductivity is determined; disorders of hydrogen atoms, connecting HSO/sub 4//sup -/ tetrahedrons with the help of the hydrogen coupling and a strong increase of HSO/sub 4/-group libration anharmonicity under the transition into the superion phase, are detected. An interesting cycle of investigations is conducted using ultracold neutrons. 16 refs.; 17 figs.

2207 Plutonium And Isotope Production Reactors

REFER ALSO TO CITATION(S) 21630, 21632, 21661, 21667

2208 Propulsion Reactors

REFER ALSO TO CITATION(S) 21579

21624 **(EPA—520/5-87-008) Radiological survey of Kings Bay Submarine Support Facility.** Windham, S.T. (Environmental Protection Agency, Montgomery, AL (USA). Eastern Environmental Radiation Facility). Oct 1987. 17p. US EPA, Off. of Radiation Prog., 401 M Street, SW, Washington, DC 20460. Order Number TI88900209/JAW.

Since 1963, the Eastern Environmental Radiation Facility (EERF), US Environmental Protection Agency (USEPA), in cooperation with the US Naval Sea Systems Command (NAVSEA) has surveyed facilities serving nuclear-powered warships on the Atlantic and Pacific coasts and the Gulf of Mexico. These surveys assess whether the operation of nuclear-powered warships, during construction, maintenance, overhaul, or refueling, have created elevated levels of radioactivity. The surveys emphasize sampling those areas and pathways that could expose the public. In 1984, NAVSEA requested that all active facilities servicing nuclear-powered warships be resurveyed over the next three years. Kings Bay Submarine Support Facility (KBSSF), located adjacent to St. Marys, Georgia and approximately 10 miles east of Kingsland, Georgia, was surveyed by EERF personnel in August 1985. The KBSSF has not been previously surveyed by the EERF or its predecessor (the US Public Health Service) since the area had not been visited by nuclear-powered warships until approximately 1980. 2 refs., 3 figs., 4 tabs.

2209 Reactor Safety

REFER ALSO TO CITATION(S) 21067, 21579, 21583, 21586, 21616, 22188, 23090, 23095, 23951

21625 **(BMU—1987-145) Probabilistic fuel rod analysis for a 1300 MW reactor with 18 x 18 bundle geometry.** Schubert, J.D. (Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany, F.R.); Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). 1987. 81p. (In German). (GRS-A—1234). GRM Werbeberatung - Werbemittlung - PR, Eggenstein-Leopoldshafen, Germany, F.R.

Schriftenreihe Reaktorsicherheit und Strahlenschutz. Ergebnisberichte, Untersuchungen, Studien, Gutachten.

This report is concerned with the probabilistic analyses ('response-surface' method, DRUFAN and TRAC computations) of a PWR with 18x18 bundle geometry during a LOCA due to a large break. With the probabilistic analyses the probability density functions and the distribution functions of the following parameters can be calculated: pellet surface temperature, stationary; pellet central temperature, stationary; rod internal pressure, stationary; heat transfer coefficient in the gap, stationary; maximum cladding temperature, transient and maximum cladding deformation, transient. With the help of deterministic SSYST-3 single rod analysis and approximation functions for temperatures and cladding deformations, expected values of core damage was determined to be 0,32%.

21626 **(BNL-NUREG—40753) Uncertainties in modelling and scaling of critical flows and pump model in TRAC-PF1/MOD1.** Rohatgi, U.S.; Yu, Wen-Shi. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 22p. (CONF-8710111—31). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006297/JAW.

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

The USNRC has established a Code Scalability, Applicability and Uncertainty (CSAU) evaluation methodology to quantify the uncertainty in the prediction of safety parameters by the best estimate codes. These codes can then be applied to evaluate the Emergency Core Cooling System (ECCS). The TRAC-PF1/MOD1 version was selected as the first code to undergo the CSAU analysis for LBLOCA applications. It was established through this methodology that break flow and pump models are among the top ranked models in the code affecting the peak clad temperature (PCT) prediction for LBLOCA. The break flow model bias or discrepancy and the uncertainty were determined by modelling the test section near the break for 12 Marviken tests. It was observed that the TRAC-PF1/MOD1 code consistently underpredicts the break flow rate and that the prediction improved with increasing pipe length (larger L/D). This is true for both subcooled and two-phase critical flows. A pump model was developed from Westinghouse (1/3 scale) data. The data represent the largest available test pump relevant to Westinghouse PWRs. It was then shown through the analysis of CE and CREARE pump data that larger pumps degrade less and also that pumps degrade less at higher pressures. Since the model developed here is based on the 1/3 scale pump and on low pressure data, it is conservative and will overpredict the degradation when applied to PWRs.

21627 **(CONF-871263—1) USNRC/ANL participation in the Lotung, Taiwan Large-Scale Soil-Structure-Interaction experiment: Validation of analysis methods.** Kot, C.A.; Srinivasan, M.G.; Hsieh, B.J.; Costello, J.F. (Argonne National Lab., IL (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering). 1987. Contract W-31109-ENG-38. 35p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005972/JAW.

From Workshop on validation of SSI methods; Palo Alto, CA, USA (9 Dec 1987).

As part of an overall effort on the validation of seismic calculational methods, the US Nuclear Regulatory Commission, Office of Research (NRC/RES) is participating in a number of international cooperative experimental programs including the Large Scale Soil-Structure-Interaction (SSI) Experiment conducted in Lotung, Taiwan by the Electric Power Research Institute (EPRI) and the Taiwan Power Company (Taipower). Argonne National Laboratory (ANL) on behalf of NRC/RES coordinates the EPRI-NRC collaboration in these experiments. The primary objective for both NRC and EPRI in the Large Scale SSI experiment is the validation/evaluation of SSI analysis methods. In addition NRC/ANL also sponsored and carried out the vibration testing of the 1/4-scale containment model. This report presents the highlights of the NRC/ANL program approach for the validation of SSI methods which differs slightly in its implementation details from the approach taken by EPRI. Also described are the vibration experiments of the 1/4-scale containment and the results of a modal analysis of the test data. Finally an effort to determine the dynamic characteristics of the soil-structure system from the earthquake response data is outlined and preliminary results are discussed. 9 refs., 12 figs., 5 tabs.

21628 **(CONF-8710279—1) A survey of recent EBR-II passive safety testing.** Planchon, H.P.; Golden, G.H.; Sackett, J.I.; Singer, R.M.; Mohr, D.; Chang, L.K.; Feldman, E.E.; Sevy, R.H. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 29p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006005/JAW.

From US/USSR joint committee meeting on experimental data and studies of core accident conditions; Argonne, IL, USA (21 Oct 1987).

During the last two years, the testing program at EBR-II has investigated the capabilities of liquid metal reactors (LMRs) to perform vital safety functions passively. In particular the tests have examined post shutdown decay heat removal by natural circulation and passive shutdown of the reactor after accidents which lead to undercooling. The undercooling accidents have been divided into two categories - the loss of flow without scram (LOFWS) (a family of events involving a loss of forced flow through the reactor), and the loss of heat sink without scram (LOHSWS) (a family of events involving a loss of the ability to transfer reactor heat to down stream components which generate steam and electricity.) The type of "passive shutdown" that has been examined is caused by natural processes - principally thermal expansion of the reactor structures, fuel and coolant. As used in this paper the term excludes automatic control of power, operator intervention or negative reactivity generated by special in-core devices. 18 refs., 7 figs., 1 tab.

21629 **(DPST—82-663-Del.Ver.) Decay heat tables for Mark 15 assemblies and fuel slugs.** Parks, P.B. (Savannah River Lab., Aiken, SC (USA)). 1988. Contract AC09-76SR00001. 87p. NTIS, PC A05. Order Number DE88005583/JAW.

Ratios of the Mark 15 power generated by β and γ decay of fission products as a function of a cooling time, T/sub c/, and the fission power during an irradiation time, T/sub I/, are given in this report. These ratios have been generated by the "ANS5.1 standard" with correctin for photon. The irradiation time vary from 5-110 days. Power ratios in the form P/sub T//sub c/ (assembly)/P/sub T/sub I/ (assembly) are provided. Bations in the form P/sub T// sub c/ (tube)/P/sub T/sub I/ (assembly) where the fuel "tube" includes only the inner cladding, fueled core, and outer cladding of either the inner or outer tube are also given. The γ energy redistribution, correction factor is slightly dependent on the cooling time because the spectrum of γ sources changes with time after shutdown. The HMTABLE code, used to generate the decay power tables, can utilize only a constant correction factor. For the sake of conservatism, maximum values of the correction factor have been used for each situation. This practice generaters power ratios too large by between ~2 and ~7% in the short cooling time calculations, and between ~3 and ~10% in the long cooling calculations.

21630 **(DPST—86-538-Del.Ver.) Support work for Technical Standard 1.05.** Crowley, D.A. (Savannah River Lab., Aiken, SC (USA)). 7 Jul 1986. Contract AC09-76SR00001. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005576/JAW.

This report documents calculations which were completed in support of an ongoing effort to revise Technical Standards. A request was made for an estimate of the amount of core damage that would occur for the design basis loss of coolant accident (LOCA) if a Mark 16B-31 charge were operating at the emergency cooling system (ECS) limit for six DC-driven pump operation, but had only five DC-driven pumps on-line.

21631 **(DPST—86-642-Del.Ver.) Ac and dc motor flooding times.** Crowley, D.A.; Hinton, J.H. (Savannah River Lab., Aiken, SC (USA)). 1988. Contract AC09-76SR00001. 16p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005577/JAW.

Reactor safety studies, such as the emergency cooling system (ECS) limits analyses and the probabilistic risk assessment, require that the flood-out times be calculated for the ac and dc motors at the -40 foot level. New calculations are needed because dams of an improved design have been installed between the pump room and motor room, and because updated leak rate calculations have shown that the maximum possible leak rate is larger than that which had been previously calculated. The methodology for calculating the motor flood-out times has also been improved. A computer program has been written to calculate flood-out times for various leak rates and sump pump operabilities. For ECS limits analyses, the worst case dc motor flood-out times are 161 and 297 seconds in LKC and P-areas, respectively. These times are for a 135,468 gpm leak that first flows to the motor room and all of the sump pumps are off.

21632 **(DPST—86-815-Del.Ver.) Emergency cooling system power limits for reactor assemblies.** Steimke, J.L. (Savannah River Lab., Aiken, SC (USA)). 1988. Contract AC09-76SR00001. 17p. NTIS, PC A03. Order Number DE88005578/JAW.

Emergency Cooling System (ECS) power limits are derived to prevent assembly melting if a design basis Loss of Coolant Accident (LOCA) occurred. An experimental and analytical study of the conditions of assembly power and coolant flow that would prevent assembly melting was done in 1979. However, a recent peer review of the study raised questions which could be answered only by further experimental work. As a result, the study was repeated. This memorandum reports some of the results from that study and associated ECS power limits.

21633 **(EGG-M—31986) One dimensional neutron kinetics in the TRAC-BF1 code.** Weaver, W.L. III; Wagner, K.C. (EG and G Idaho, Inc., Idaho Falls (USA)). 1987. Contract AC07-76ID01570. 9p. (CONF-870418—9). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005543/JAW.

From Topical meeting on anticipated and abnormal transients in nuclear power plants; Atlanta, GA, USA (12 Apr 1987).

The TRAC-BWR Code Development Program at the Idaho National Engineering Laboratory is developing a version of the TRAC code for the US Nuclear Regulatory Commission (USNRC) to provide a best-estimate analysis capability for the simulation of postulated accidents in Boiling Water Reactor (BWR) power systems and related experimental facilities. Recent development efforts in the TRAC-BWR program have focused on improving the computational efficiency through the incorporation of a hybrid Courant-limit-violating numerical solution scheme in the one-dimensional component models and on improving code accuracy through the development of a one-dimensional neutron kinetics mode. Many other improvements have been incorporated into TRAC-BWR to improve code portability, accuracy, efficiency, and maintainability. This paper will describe the one-dimensional neutron kinetics model, the generation of the required input data for this model, and present results of the first calculations using the model. 8 refs., 6 figs.

21634 **(EGG-SSRE—7899) A scoping study of fission product transport from failed fuel during N Reactor postulated accidents.** Hagrman, D.L. (EG and G Idaho, Inc., Idaho Falls (USA)). Nov 1987. Contract AC07-76ID01570. 100p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88005537/JAW.

This report presents a scoping study of cesium, iodine, and tellurium behavior during a cold leg manifold break in the N Reactor. More detail about fission product behavior than has previously been available is provided and key parameters that control this behavior are identified. The LACE LA1 test and evidence from the Power Burst Facility Severe Fuel Damage tests are used to test the key model applied to determine aerosol behavior. Recommendations for future analysis are also provided. The primary result is that most of the cesium, iodine, and tellurium remains in the molten uranium fuel. Only 0.0035 of the total inventory is calculated to be released. Condensation of most of the species of cesium and iodine that are released is calculated, with 0.998 of the released cesium and iodine condensing in the spacers and upstream end of the connector tubes. Most of the tellurium that is released condenses but the chemical reaction of tellurium vapor with surfaces is also a major factor in the behavior of this element.

21635 **(EGG-WM—7845) Conceptual design report: Decontamination and decommissioning of the EBR-1 Mark-2 NaK.** Brown, B.W.; La Rue, D.M.; Stoll, F.E.; Dolenc, M.R.; Crandall, D.L. (EG and G Idaho, Inc., Idaho Falls (USA)). Sep 1987. Contract AC07-76ID01570. 216p. NTIS, PC A10. Order Number DE88005459/JAW.

A conceptual design of a processing system for approximately 180 gallons of contaminated NaK (sodium/potassium eutectic alloy) is presented. This NaK resulted from an incident at EBR-1 at the Idaho National Engineering Laboratory in 1955. The proposed method of decommissioning the NaK is to chemically deactivate it by combining it with gaseous chlorine. This process will produce a solid mass of potassium chloride and sodium chloride salts which will mitigate the consequences of further chemical reaction of the NaK should the storage containers be breached in any way. Following the processing of the NaK, the storage vessels will be transferred to an appropriate storage facility for radioactive wastes. 10 refs., 12 figs., 1 tab.

21636 **(EPRI-NP—3459-Vol.2) Experimental study of diversion cross-flow caused by subchannel blockages: Volume 2, Two-phase flow: Final report.** Tapucu, A.; Teyssedou, A.; Geckinli, M.; Troche, N. (Ecole Polytechnique, Montreal, Quebec (Canada)). Feb 1988. 513p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920197/JAW.

Experiments were performed to study the effects of a blockage in one subchannel of a two-subchannel test section model of a reactor fuel bundle. Smooth- and sharp-edged blockages were used. The test fluid consisted of two-phase air-water mixtures. The data were compared with calculated results obtained from the COBRA III-C code. Good agreement was obtained from smooth blockages of less than 60% and for sharp blockages of less than 30%. 35 refs., 206 figs., 17 tabs.

21637 **(EPRI-NP—5531) Evaluation of high-energy pipe rupture experiments: Final report.** Gerber, T.L.; Kuo, A.Y.; Copeland, J.F.; Abdollahian, D. (Structural Integrity Associates, San Jose, CA (USA); Levy (S.), Inc., Campbell, CA (USA)). Jan 1988. 104p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920175/JAW.

Fracture mechanics and thermal hydraulic evaluations of the EPRI high energy pipe rupture experiments have been carried out. The purpose of these evaluations was to benchmark analytical methods with prototypical pipe leak and rupture behavior. Fracture mechanics predictions were made using methods and materials property data available in the literature. Conditions which were predicted to produce a pipe leak did result in a leak while conditions expected to result in pipe rupture did rupture. Further, system blowdown following breaching of the pipe wall does not appear to influence the pipe leak or rupture behavior except for long axial defects. The thermal hydraulic behavior of the EPRI high energy pipe tests was typical of system blowdowns from an initial subcooled condition. Predictions of vessel depressurization, discharge flow rate from the final crack opening area, and blowdown thrust forces are consistent with observations. 22 refs., 18 figs., 12 tabs.

21638 **(EPRI-NP—5577) Modeling of ground-motion attenuation in eastern North America: Final report.** Barker, J.S.; Somerville, P.G.; McLaren, J.P. (Woodward-Clyde Consultants, Pasadena, CA (USA)). Feb 1988. 408p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920198/JAW.

In this study, we have used our understanding of the physics of elastic wave propagation to simulate ground motions within 100 km from earthquakes in eastern North America. Detailed crustal velocity structure models were developed for sources located in the Grenville and Appalachian provinces. The former consists of a single gradient in the crust, and was constrained by modeling S waves generated by explosions from a crustal refraction experiment. The latter contains a mid-crustal discontinuity and a deep Moho, and was developed by modeling P and S travel times and amplitudes from three earthquakes at two depths. 44 refs., 193 figs., 11 tabs.

21639 **(EPRI-NP—5607) The 1986 North Palm Springs Earthquake: Effects on power facilities: Final report.** Swan, S.; Hadjian, A.H. (EQE, Inc., San Francisco, CA (USA); Bechtel Power Corp., Norwalk, CA (USA)). Jan 1988. 79p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920181/JAW.

The North Palm Springs Earthquake of July 8, 1986, was centered near a large electrical substation. Strong motion records were taken on the substation site and at several other locations in the epicentral area. The recorded peak ground accelerations of 0.97g (north-south), 0.48g (vertical), and 0.72g (east-west) are the highest ever measured at a major electric power facilty. Earthquake damage in the ceramic components of switchyard equipment ranged from moderate to extensive, depending on the design of the equipment. Anchorage of heavy switchyard equipment such as transformers and reactors deformed, and in one instance failed in bolt shearing. Control and instrumentation systems at the substation, and at nearby power generation facilities, were undamaged by the earthquake. 5 refs., 42 figs., 12 tabs.

21640 **(EPRI-NP—5613-Vol.1) Procedures for treating common cause failures in safety and reliability studies: Volume 1, Procedural framework and examples: Final report.** Mosleh, A.; Fleming, K.N.; Parry, G.W.; Paula, H.M.; Worledge, D.H.; Rasmuson, D.M. (Pickard, Lowe and Garrick, Inc., Newport Beach, CA (USA)). Feb 1988. 205p. (NUREG/CR—4780). Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920199/JAW.

This report presents a framework for the inclusion of the impact of common cause failures in risk and reliability evaluations. Common cause failures are defined as that cutset of dependent failures for which causes are not explicitly included in the logic model as basic events. The emphasis here is on providing procedures for a practical, systematic approach that can be used to perform and clearly document the analysis. The framework comprises four major stages: (1) system logic model development; (2) identification of common cause component groups; (3) common cause modeling and data analysis; (4) system quantification and interpretation of results. The framework and the methods discussed for performing the different stages of the analysis integrate insights obtained from engineering assessments of the system and the historical evidence from multiple failure events into a systematic, reproducible, and defensible analysis. 22 figs., 34 tabs.

21641 **(EPRI-NP—5616) Investigation of the San Salvador earthquake of October 10, 1986: Effects on power and industrial facilities: Final report.** Swan, S. (EQE, Inc., San Francisco, CA (USA)). Feb 1988. 76p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920208/JAW.

A magnitude 5.4 earthquake struck the city of San Salvador on October 10, 1986. An EPRI sponsored investigation was conducted in conjunction with a team of engineers from the Earthquake Engineering Research Institute. The team surveyed the earthquake-affected area during the week following the event. The reconnaissance included three days in the San Salvador area to review the earthquake performance of power and industrial facilities and the general effects of the earthquake. The earthquake affected no major power generation facilities. However, two 115 kV substations serving San Salvador experienced strong ground motion. Both substations sustained minor damage from the earthquake. Water pumping facilities and a typical industrial installation were also briefly investigated. In general the earthquake reinforces the observation that high acceleration can be endured for moderate durations by typical power and industrial equipment installations, with the exception of ceramic components of high voltage switchgear.

21642 **(EPRI-NP—5617-Vol.2) Recommended piping seismic-adequacy criteria based on performance during and after earthquakes: Volume 2, Reference document: Final report.** Silver, M.M.; Hardy, G.S.; Smith, P.D.; Yanev, P.I.; Harris, S.P. (EQE, Inc., San Francisco, CA (USA)). Jan 1988. 167p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920173/JAW.

Data from fossil, nuclear, and other industrial plants confirm that aboveground welded steel piping performs well when subjected to earthquakes with peak ground motions up to 0.5 g. Seismic anchor movement, system interaction, and corrosion - rather than seismic inertia loads - appear to be the primary failure causes. This volume contains detailed background data including photographs, drawings, and specifications of the inspected facilities. 65 refs., 30 figs., 3 tabs.

21643 **(IA—1420) Evacuation of the population as a means of mitigating the radiological effects following an accidental atmospheric release of radioactivity from a nuclear power plant.** Gants, E. (Israel Atomic Energy Commission, Yavne. Soreq Nuclear Research Center). Aug 1985. 135p. (In Hebrew). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701019/JAW.

Evacuation of the population in the vicinity of a nuclear power plant following an accidental release of radioactivity into the atmosphere, is one of the protective means which might reduce the

radiation doses and radiological effects caused to the population. An evacuation simulation model - RECLEAR - was developed in order to investigate the dependency of the evacuation efficiency on various parameters. It was found that the efficiency is dependent on many factors - meteorological, demographic and transportation parameters. RECLEAR was developed by coupling two computer codes: a) CLEAR (Mo82) a simulation model which calculates the time required to evacuate the population from a given area - Emergency Planning Zone (EPZ) and b) REMAND (St85) - a radiological consequence model which evaluates the radiation doses and radiological effects caused to (a stationary) population, following an accident in a nuclear power plant. RECLEAR is a simulation code which calculates the evacuation duration as well as the radiation doses to the population, received while evacuating. The code describes the progress of individual vehicles along the site's specific road network (composed of road segments), using the relationships between traffic flow rates, travel velocity and road capacity in each road segment. The code also simulates traffic jams and intersections. Preliminary results reveal two main factors that might effect the efficiency of evacuation: 1) The traffic density during evacuation and 2) The delay of the population before onset of movement. It should be emphasized that the results presented in this study are of a preliminary nature, however, the model and the results received so far might constitute a basis for further work on the subject and it can also be used as a tool in non-radiological emergency planning and, with some adaptions, as a means of a real-time hazards evaluation.

21644 (INIS-mf—10580-Vol.2, pp 53-57) Personnel dose commitment from external and internal irradiation during Kozloduj NPP operation. Khitov, G.; Dichev, G.; Stefanov, G.; Keslev, D. 1983. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE87780113/JAW. (CONF-8205317—Vol.2).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

Organizing measures and guiding documentations are described as a basis for individual personnel monitoring. Both personnel collective dose and mean annual individual dose commitment distributions over years are presented. The major factors determining external and internal irradiation of personnel operating WWER-440 are considered as well as the annual dose distribution during NPP operation and main repair works. Organizing and technical measures for personnel radiation exposure reduction are discussed. 2 refs.; 3 tabs.

21645 (INIS-XN—82) Ministerial Order of 9 March 1987 on the register concerning nuclear installations. (International Atomic Energy Agency, Vienna (Austria)). 13 Mar 1987. 2p. (In French and Dutch). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701089/JAW.

Published in Moniteur belge.

The purpose of this Order is to implement the Act of 22nd July 1985 on Third Party Liability in the Field of Nuclear Energy regarding the obligation to make available to the public the register containing the texts granting recognition to the operators of nuclear installations. It states that a register comprising a certified true copy of the royal decrees granting recognition and a map showing the location and boundaries of the site of each installation must be made available to the public by the Ministry of Economic Affairs in Brussels. (NEA).

21646 (INIS-XN—112) 20 December Act No. 103 amending Act No. 28 of 12 May 1972 on Nuclear Energy Activities. (International Atomic Energy Agency, Vienna (Austria)). 20 Dec 1985. 7p. (In Norwegian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701095/JAW.

English translation provided.

This Act amended the 1972 Act to take account of the ratification by Norway of the Protocols of 1982 to amend the Paris Convention on Third Party Liability in the Field of Nuclear Energy and the Brussels Supplementary Convention respectively. The amendments bring the third party liability provisions of the Act in line with the Conventions as amended by the Protocols. The modifications concern, inter alia, certain definitions, conversion of the unit of account into the Special Drawing Right (SDR) of the International Monetary Fund and increases in the amount of liability assigned at State level by a factor of approximately 2.5. (NEA).

21647 (JAERI—1300) THYDE-P2 code: RCS (reactor-coolant system) analysis code. Asahi, Y.; Hirano, M.; Sato, K. (Japan Atomic Energy Research Inst., Tokyo). Dec 1986. 183p. NTIS (US Sales Only), PC A09/MF A01. Order Number DE87702952/JAW.

THYDE-P2, being characterized by the new thermal-hydraulic network model, is applicable to analysis of RCS behaviors in response to various disturbances including LB (large break)-LOCA(loss-of-coolant accident). In LB-LOCA analysis, THYDE-P2 is capable of through calculation from its initiation to complete reflooding of the core without an artificial change in the methods and models. The first half of the report is the description of the methods and models for use in the THYDE-P2 code, i.e., (1) the thermal-hydraulic network model, (2) the various RCS components models, (3) the heat sources in fuel, (4) the heat-transfer correlations, (5) the mechanical behavior of clad and fuel, and (6) the steady-state adjustment. The second half of the report is the user's mannual for the THYDE-P2 code (version SV04L08A) containing items; (1) the program control (2) the input requirements, (3) the execution of THYDE-P2 job, (4) the output specifications and (5) the sample problem to demonstrate capability of the thermal-hydraulic network model, among other things.

21648 (JAERI-M—86-186) Conversion tool for the LWR transient analysis code RELAP5 from the CDC version to the FACOM version. Shinozawa, N.; Fujisaki, M.; Makino, M.; Kondou, K.; Ishiguro, M. (Japan Atomic Energy Research Inst., Tokyo). Jan 1987. 110p. (In Japanese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE87702958/JAW.

The LWR transient analysis code RELAP5 was developed on the CDC-CYBER 176 at Idaho National Engineering Laboratory (INEL), the RELAP5 code has been often updated in order to extend the analyzing model and correct the errors. At Japan Atomic Energy Research Institute the code was converted from the CDC version to the FACOM version and the converted code was used. The conversion consumes a lot of time, because the code is large and there is the difference between CDC's machines and FACOM's ones. In order to convert the RELAP5 code automatically, the software tool was developed. By using this tool the efficiency for converting the RELAP5 code was improved. Productivity of the conversion is increased about 2.0 to 2.6 times in comparison with the manual. The procedure of conversion by using the tools and the option parameters of each tool are described.

21649 (JAERI-M—87-002) Evaluation report on CCTF Core-II reflood test C2-9 (Run 68). Effect of LPCI flow rate. Akimoto, H.; Iguchi, T.; Okubo, T.; Murao, Y.; Okabe, K.; Sugimoto, J. (Japan Atomic Energy Research Inst., Tokyo). Feb 1987. 84p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE87702960/JAW.

In order to study the LPCI flow-rate effect on the core cooling and system behavior, a test was performed with the LPCI flow rate of 0.025 m^3/s, which corresponds to the flow rate in case of no pump failure in a PWR system. Through the comparisons of test results with those from the reference test with the LPCI flow rate of 0.011 m^3/s, the following conclusions were obtained: (1) The higher LPCI flow rate resulted in the worse core-cooling in these two tests. The test results show that the lower LPCI flow rate is not necessarily a conservative assumption for the evaluation of the core cooling during the reflood phase of a PWR LOCA. (2) The worse core-cooling in the high-LPCI flow-rate test is attributed to the lower core pressure than in the reference test. It is found that the lower core pressure results from the lower pressure drop through the broken cold leg. (3) It is expected that the current evaluation model(EM) code is still conservative because it usually predicts the low-pressure drop through the broken cold leg. (4) The flow oscillation in the cold leg was not significant even in the high-LPCI flow rate test before the whole core quench.

21650 **(NUREG/CR—4659-Vol.2) Seismic fragility of nuclear power plant components: Phase 2, Motor control center, switchboard, panelboard and power supply.** Bandyopadhyay, K.K.; Hofmayer, C.H.; Kassir, M.K.; Pepper, S.E. (Brookhaven National Lab., Upton, NY (USA)). Dec 1987. Contract AC02-76CH00016. 118p. (BNL-NUREG—52007-Vol.2). NTIS, PC A06/MF A01 - GPO. Order Number TI88005471/JAW.

In Phase I of the Component Fragility Program, Brookhaven National Laboratory (BNL) has developed a procedure to establish the seismic fragility of nuclear power plant equipment by use of existing test data and demonstrated its application by considering two equipment pieces. In Phase II of the program, BNL has collected additional test data, and has further advanced and is applying the methodology to determine the fragility levels of selected essential equipment categories. The data evaluation of four equipment families, namely, motor control center, switchboard, panelboard and power supply has been completed. Fragility levels have been determined for various failure modes of each equipment class and the deterministic results are presented in terms of test response spectra. In addition, the test data have been analyzed for determination of the respective probabilistic fragility levels. To this end, a single g-value has been selected to approximately represent the test vibration level and a statistical analysis has been performed with the g-values corresponding to a particular failure mode. The zero period acceleration and the average spectral acceleration over a frequency range of interest are separately used as the single g-value. The resulting parameters are presented in terms of a median value, an uncertainty coefficient and a randomness coefficient. Ultimately, each fragility level is expressed in terms of a single descriptor called an HCLPF value corresponding to a high (95%) confidence of a low (5%) probability of failure. The important observations made in the process of data analysis are included in this report.

21651 **(NUREG/CR—4780-Vol.1) Procedures for treating common cause failures in safety and reliability studies: Procedural framework and examples.** Mosleh, A.; Fleming, K.N.; Parry, G.W.; Paula, H.M.; Worledge, D.H.; Rasmuson, D.M. (Pickard, Lowe and Garrick, Inc., Newport Beach, CA (USA)). Jan 1988. 201p. (EPRI-NP—5613-Vol.1). NTIS, PC A10/MF A01 - GPO. Order Number TI88900441/JAW.

This report presents a framework for the inclusion of the impact of common cause failures in risk and reliability evaluations. Common cause failures are defined as that cutset of dependent failures for which causes are not explicitly included in the logic model as basic events. The emphasis here is on providing procedures for a practical, systematic approach that can be used to perform and clearly document the analysis. The framework comprises four major stages: (1) System Logic Model Development; (2) Identification of Common Cause Component Groups; (3) Common Cause Modeling and Data Analysis; and (4) System Quantification and Interpretation of Results. The framework and the methods discussed for performing the different stages of the analysis integrate insights obtained from engineering assessments of the system and the historical evidence from multiple failure events into a systematic, reproducible, and defensible analysis. 22 figs., 34 tabs.

21652 **(NUREG/CR—4805/2-Vol.36) Reactor Safety Research: Semiannual report, July-December 1986.** (Sandia National Labs., Albuquerque, NM (USA)). Nov 1987. Contract AC04-76DP00789. 327p. (SAND—86-2752/2-Vol.36). NTIS, PC A15/MF A01 - GPO. Order Number TI88006015/JAW.

Sandia National Laboratories is conducting, under USNRC sponsorship, phenomenological research related to the safety of commercial nuclear power reactors. The research includes experiments to simulate the phenomenology of the accident conditions and the development of analytical models, verified by experiment, which can be used to predict reactor and safety systems performance and behavior under abnormal conditions. The objective of this work is to provide NRC requisite data bases and analytical methods to (1) identify and define safety issues, (2) understand the progression of risk-significant accident sequences, and (3) conduct safety assessments. The collective NRC-sponsored effort at Sandia National Laboratories is directed at enhancing the tehcnology base supporting licensing decisions.

21653 **(NUREG/CR—4834/2) Recovery actions in PRA (Probabilistic Risk Assessment) for the risk methods integration and evaluation program (RMIEP): Volume 2, Application of the data-based method.** Whitehead, D.W. (Sandia National Labs., Albuquerque, NM (USA)). Dec 1987. Contract AC04-76DP00789. 52p. (SAND—87-0179/2). NTIS, PC A04/MF A01 - GPO. Order Number TI88006192/JAW.

In a Probabilistic Risk Assessment (PRA) for a nuclear power plant, the analyst identifies a set of potential core damage events and their estimated probabilities of occurrence. These events include both equipment failures and human errors. If operator recovery from an event within some specified time is considered, the probability of this recovery can be included in the PRA. This report provides PRA analysts with a step-by-step methodology for including recovery actions in a PRA. The recovery action is divided into two distinct phases: a Diagnosis Phase (realizing that there is a problem with a critical parameter and deciding upon the correct course of action) and an Action Phase (physically accomplishing the required action). In this methodology, time-reliability curves, which were developed from simulator data on potentially dominant accident scenarios, are used to provide estimates for the Diagnosis Phase, and other existing methodologies are used to provide estimates for the Action Phase.

21654 **(NUREG/CR—4917) DCH-2: Results from the second experiment performed in the Surtsey Direct Heating Test Facility.** Tarbell, W.W.; Nichols, R.T.; Brockmann, J.E.; Ross, J.W.; Oliver, M.S.; Lucero, D.A. (Sandia National Labs., Albuquerque, NM (USA)). Jan 1988. Contract AC04-76DP00789. 99p. (SAND—87-0976). NTIS, PC A05/MF A01 - GPO. Order Number TI88006207/JAW.

This test involved 80 kg of molten core debris simulant ejected under pressure into a 1:10 linear scale model of a reactor cavity. The apparatus was placed in the Surtsey Direct Heating Test Facility to allow direct measurement of the temperature and pressure rise of the contained atmosphere. The molten material was ejected from the cavity as a dense cloud of particles and gas. The dispersed debris caused a rapid pressurization of the 103-m^3 atmosphere. Peak pressures ranged from 0.22 to 0.31 MPa above the ambient level. Peak temperatures were from 759°C to 1335°C, with the highest values recorded near the top of the chamber. Much of the debris (~70%) was found adhered to the top and sides of the steel chamber. The pattern of the retained material suggested that the debris field propagated around the chamber following the contour of the vessel. Aerosol measurements indicated that ~1% to ~6.6% of the ejected mass was in the size range less than 10μm aerodynamic diameter. 8 refs., 28 figs., 6 tabs.

21655 **(NUREG/CR—4992-Vol.1) Aging and service wear of multistage switches used in safety systems of nuclear power plants: Volume 1, Operating experience and failure identification.** Roberts, G.C.; Bacanskas, V.P.; Toman, G.J. (Franklin Research Center, Philadelphia, PA (USA)). Sep 1987. Contract AC05-84OR21400. 57p. (ORNL/Sub—83-28915/5-Vol.1). NTIS, PC A04/MF A01 - GPO. Order Number TI88004185/JAW.

An assessment of the types and uses of multistage switches in nuclear power plant safety-related service is provided. Through a description of the operation of each type of switch, combined with knowledge of nuclear power plant applications and operational occurrences, the significant stressors responsible for multistage switch deterioration are identified. A review of operating experience (failure data) leads to identification of potential monitoring techniques for early detection of incipient failures. Although the operating experience does not justify extensive deterioration monitoring of multistage switches, nondestructive testing methods that could be used to evaluate the condition of switches are identified.

21656 **(NUREG/CR—4998) The Seismic Category 1 Structures Program: Results for FY 1985.** Bennett, J.G.; Dove, R.C.; Dunwoody, W.E.; Farrar, C.R.; Goldman, P. (Los Alamos National Lab., NM (USA)). Dec 1987. Contract W-7405-ENG-36. 45p. (LA—11117-MS). NTIS, PC A03/MF A01 - GPO. Order Number TI88002521/JAW.

In FY 1985 a new effort was begun to resolve an issue that became the "stiffness difference issue." This issue came about from reporting the results from testing both isolated shear walls and box-like shear deformation-dominated scale models that showed a consistent reduction in structural stiffness measured experimentally. This structural stiffness was different from that which would be calculated analytically at loads associated with operating basis earthquake levels. Several possible explanations were proposed for the experimental/analytical difference (most likely attributable to cracking of the concrete models). Possibilities are microcracking at very low loads, microconcrete effects, such as shrinkage cracks, unaccounted for dynamic effects in the analyses, and low stress level, low-cycle, fatigue degradation of microconcrete properties. A new configuration was proposed by the Technical Review Group (TRG) for this program and, in FY 1985, a prototype structure was designed. A 1/4-scale microconcrete model of the prototype structure was constructed and tested. This report details that investigation, but it does not report the resolution of the "stiffness difference" issue, an investigation that was ongoing at the end of FY 1985. 10 refs., 28 figs., 9 tabs.

21657 (NUREG/CR—5073) Quantification of margins in piping system seismic response: Methodologies and damping. Johnson, J.J.; Benda, B.J. (EQE, Inc., San Ramon, CA (USA)). Feb 1988. Contract W-7405-ENG-48. 146p. (UCRL—21000). NTIS, PC A07/MF A01 - GPO. Order Number TI88006079/JAW.

The conservation of seismic analysis and design of piping systems due to analysis methodologies and damping values was quantified. Envelope response spectrum analyses, independent support motion response analyses, and multi-support time history analysis methodologies were evaluated. Constant damping, ranging from 1% to 10%, and PVRC damping were considered. Conservatisms were evaluated with respect to best estimate response of the entire seismic analysis chain and of the piping system alone. 18 refs., 15 figs., 10 tabs.

21658 (PB—88-134267/XAB) Seismic probabilistic risk assessment and seismic-margins studies for nuclear power plants. Technical report. Hwang, H.H.M. (National Center for Earthquake Engineering Research, Buffalo, NY (USA)). 15 Jun 1987. 32p. (NCEER—87-0011). NTIS, PC A03/MF A01.

This report presents a review of the seismic probabilistic risk assessment and seismic margins studies for nuclear power plants in the United States. The techniques employed in these studies are briefly described. A few comments on the evaluation of the fragility of structures and equipment are discussed. Seismic PRA is a systematic process to evaluate the safety of nuclear power plants. In the process, it integrates all the elements such as seismic hazard, component fragility and plant system. Thus, it provides the overall view of the safety of an entire plant under a seismic event. The major tasks of a seismic PRA such as the evaluation of hazard curves, component fragilities. The concept and technique embodied in seismic PRA for nuclear power plants can be applied to other types of engineering facilities.

21659 (PNL-SA—14846) Emergency preparedness lessons from Chernobyl. Martin, J.B. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1987. Contract AC06-76RL01830. 10p. (CONF-871202—4). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005525/JAW.

From 21. mid-year meeting of the Health Physics Society: power reactor health physics; Miami Beach, FL, USA (12 Dec 1987).

Emergency preparedness at nuclear power plants in the US has been considerably enhanced since the Three Mile Island accident. The Chernobyl accident has provided valuable data that can be used to evaluate the merit of some of these enhancements and to determine the need for additional improvements. For example, the USSR intervention levels of 25 rem and 75 rem for evacuation are contrasted with US Environmental Protection Agency protective action guides. The manner in which 135,000 persons were evacuated from the 30-km zone around Chernobyl is contrasted with typical US evacuation plans. Meteorological conditions and particulate deposition patterns were studied to infer characteristics of the radioactive plume from Chernobyl. Typical plume monitoring techniques are examined in light of lessons learned by the Soviets about plume behavior. This review has indicated a need for additional improvements in utility and government emergency plans, procedures, equipment, and training. 12 refs., 1 fig., 2 tabs.

21660 (RFP—4078) Rockwell International's Nuclear Criticality Safety Program at the Rocky Flats Plant. McCarthy, J.D. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 1987. Contract AC04-76DP03533. 38p. (CONF-871045—13). NTIS, PC A03. Order Number DE88005149/JAW.

From International seminar on nuclear criticality safety; Tokyo, Japan (19 Oct 1987).

This paper describes the criticality safety program at the Rocky Flats Plant. The groups responsible for safety are named and their functions outlined. (JDH)

21661 (RTR—2341-Del.Ver.) Uncertainty analysis of emergency cooling system flows. Mcallister, J.E. Jr. (Savannah River Lab., Aiken, SC (USA)). 1988. Contract AC09-76SR00001. 10p. NTIS, PC A02. Order Number DE88005580/JAW.

The Emergency Cooling System (ECS) for SRP reactors is designed to provide core cooling for postulated incidents. Recently, tests were completed in L Reactor to better define pipeline and fitting loss coefficients that are needed to predict ECS flows. Because the existing flow data are primarily based on experimental data, an experimental uncertainty exists in those flows and respective loss coefficients. The uncertainty analysis and resulting uncertainties of the data are discussed in this report.

21662 (RTR—2347-Del.Ver.) Hydraulic tests of emergency cooling system: L-Area. Hinton, J.H. (Savannah River Lab., Aiken, SC (USA)). 1988. Contract AC09-76SR00001. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005581/JAW.

The delay in L-Area startup provided an opportunity to obtain valuable data on the Emergency Cooling System (ECS) which will permit reactor operation at the highest safe power level. ECS flow is a major input to the FLOOD code which calculates reactor ECS power limits. The FLOOD code assesses the effectiveness of the ECS cooling capacity by modeling the core and plenum hydraulics under accident conditions. Presently, reactor power is not limited by the ECS cooling capacity (power limit). However, the manual calculations of ECS flows had been recently updated to include piping changes (debris strainer, valve changes, pressure release systems) and update fitting losses. Both updates resulted in reduced calculated ECS flows. Upon completion of the current program to update, validate, and document, reactor power may be limited under certain situations by ECS cooling capacity for some present reactor charge designs. A series of special hydraulic tests (Reference 1, 3) were conducted in L-Area using all sources of emergency coolant including the ECS pumps (Reference 2). The tests provided empirical hydraulic data on the ECS piping. These data will be used in computer models of the system as well as manual calculations of ECS flows. The improved modeling and accuracy of the flow calculations will permit reactor operation at the highest safe power level with respect to an ECS power limit.

21663 (SAND—87-2041C) Recent results of the containment performance programs. von Riesemann, W.A.; Horschel, D.S.; Clauss, D.B.; Lambert, L.D. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 31p. (CONF-8710111—30). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006098/JAW.

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

This paper provides the results of recent experimental and analytical studies conducted by Sandia National Laboratories to predict containment response under severe accident conditions. These studies, have previously included investigation into the behavior of steel containments when subjected to overpressurization. The thrust of this paper is to report the results of the recent test that was conducted on a 1:6-scale reinforced concrete containment

model and of the test of a full-size personnel air lock. The paper first discusses the 1:6-scale concrete model (design, construction, instrumentation, and low- and high-pressure testing). The analyses performed on the model are discussed briefly; additional information may be obtained from the citations. The paper concludes with a description of the recent personnel air lock test. 15 refs., 13 figs., 2 tabs.

21664 **(SAND—87-2225C) Pressure threat to containment due to flame acceleration.** Cummings, J.C.; Torczynski, J.R.; Benedick, W.B. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 23p. (CONF-880309—2; IAEA-SM—296/111). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006202/JAW.

From International symposium on severe accidents in nuclear power plants; Sorrento, Italy (21 Mar 1988).

Since the accident at Three Mile Island in 1979, there has been significant concern about the threat to nuclear power plants caused by the combustion of hydrogen generated during a loss-of-coolant accident (LOCA). This paper discusses the results of a study of one aspect of that concern: the acceleration of flames due to venting and obstacles (which could occur inside a containment building). The peak overpressures generated by accelerated flames are sufficient to threaten the integrity of some nuclear power plant containment buildings. Our study included a series of experiments conducted using mixtures of hydrogen and air, as well as the development of a numerical model of the phenomena. The experiments employed a large cylindrical combustion vessel that could be either closed or vented at the end opposite the igniter. Combustible mixtures used in the study contained either 15% or 30% hydrogen air. Information obtained from this test series included flame trajectories, flame front profiles, and combustion-generated pressure histories.

21665 **(SAND—87-2473) Predicting emergency diesel performance.** DeBey, T.M. (Sandia National Labs., Albuquerque, NM (USA)). Jan 1988. Contract AC04-76DP00789. 58p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88006584/JAW.

The Department of Energy (DOE) Nuclear Plant Lifetime Improvement Program is looking at methods for predicting equipment performance so that degradation and failures can be detected before they become severe enough to limit plant performance. It is believed that prognostic monitoring techniques may provide a viable alternative to replacing or refurbishing equipment to facilitiate operation of commercial light water reactors beyond 40 years. One segment of this effort has been directed at emergency diesel systems, with the emergency diesel-driven pumps at the N-reactor serving as the specific items of interest. The N-reactor diesels are similar in size, operating requirements, and operating history to those in commercial plants. In addition, the N-reactor diesels have been in service longer than any of the commercial units and are therefore valuable from a viewpoint of aged equipment analysis.

21666 **(SAND—88-0379C) Acoustic detection of melt particles.** Costley, R.D. Jr. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 12p. (CONF-880160—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006101/JAW.

From 30. meeting of the Weapons Agencies Nondestructive Testing Organization (WANTO); Largo, FL, USA (12 Jan 1988).

The Reactor Safety Research Department at Sandia National Laboratories is investigating a type of Loss of Coolant Accident (LOCA). In this particular type of accident, core meltdown occurs while the pressure within the reactor pressure vessel (RPV) is high. If one of the instrument tube penetrations in the lower head fails, melt particles stream through the cavity and into the containment vessel. This experiment, which simulates this type accident, was performed in the Surtsev Direct Heating Test Facility which is approximately a 1:10 linear scaling of a large dry containment volume. A 1:10 linear scale model of the reactor cavity was placed near the bottom of the Surtsey vessel so that the exit of the cavity was at the vertical centerline of the vessel. A pressure vessel used to create the simulated molten core debris was located at the scaled height of the RPV. In order to better understand how the melt leaves the cavity and streams into the containment an array of five acoustic sensors was placed directly in the path of the melt particles about 30 feet from the exit of the sealed cavity. Highly damped, broadband sensors were chosen to minimize ringing so that individual particle hits could be detected. The goal was to count the signals produced by the individual particle hits to get some idea of how the melt particles left the cavity. This document presents some of the results of the experiment. 9 figs.

21667 **(WHC-EP—0035) Safety assessment of N Reactor.** Simpson, D.E.; Arnold, W.H.; Schwallie, A.L.; McAdoo, J.D.; Fauske, H.K. (Westinghouse Hanford Co., Richland, WA (USA)). Jul 1987. Contract AC06-87RL11327;AC06-87RL10930. 51p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88006089/JAW.

Westinghouse has performed a safety assessment of the N Reactor, in response to a request from the US Department of Energy (DOE). The assessment was performed by people from several Westinghouse nuclear energy organizations, who are experienced in design, safety analysis, and operation of commercial nuclear power reactors and DOE advanced and production reactors. A number of actions were identified to confirm and improve the safety of the N Reactor which Westinghouse will implement in the course of the current plant outage, start-up and continued operations. It is concluded that the implementation of these actions will confirm that the N Reactor is safe and acceptable for operation. 16 refs.

21668 **Evaluation of uncertainties in risk emanating from a number of severe accident issues.** Benjamin, A.S.; Kunsman, D.M.; Boyd, G.R.; Murfin, W.B. (Sandia National Labs., Albuquerque, NM, USA; Safety and Reliability Optimization Services, Knoxville, TN, USA; Technadyne, Albuquerque, NM, USA). *Nuclear Engineering and Design;* **104**: No. 3, 249-266(Nov 1987). (CONF-860507—). Contract AC04-76DP00789.

From 3. workshop on integrity of containments for nuclear power plants; Washington, DC, USA (21 May 1986).

A study has been performed to estimate, for a particular pressurized water reactor, the uncertainty in risk associated with a number of key phenomenological issues. A second objective was to distinguish the individual importance of the various issues as contributors to the overall uncertainty in risk. The issues considered touched upon the areas of system behavior, containment loading, containment performance, and fission product source term behavior. It was found that the most important source of uncertainty for the plant in question (Surry) was direct containment heating (i.e., the transfer of heat from the core debris to the containment atmosphere when the debris is ejected at high pressure from the reactor vessel and dispersed throughout the atmosphere). Other significant issues included hydrogen burning, containment failure pressure, aerosol agglomeration uncertainties, the frequency of check valve failures leading to a loss-of-coolant accident (LOCA) outside containment, and the potential for having a LOCA induced by high temperatures in the reactor coolant system.

21669 **Seismic risk assessment of a BWR.** Wells, J.E.; Bernreuter, D.L.; Chen, J.C.; Lappa, D.A.; Chuang, T.Y.; Murray, R.C.; Johnson, J.J. (Lawrence Livermore National Lab., CA, USA; EQE, Inc., San Ramon, CA, USA). pp 337-342 of Transactions of the 9th international conference on structural mechanics in reactor technology. Vol. A. Indexes, abbreviations, supplement. Wittmann, F.H. (ed.). Rotterdam, Netherlands; Balkema (1987). (CONF-870812—).

From 9. SMIRT: international conference on structural mechanics in reactor technology; Lausanne, Switzerland (17 Aug 1987).

The simplified seismic risk methodology developed in the USNRC Seismic Safety Margins Research Program (SSMRP) was demonstrated by its application to the Zion nuclear power plant (PWR). The simplified seismic risk methodology was developed to reduce the costs associated with a seismic risk analysis while providing adequate results. A detailed model of Zion, including systems analysis models (initiating events, event trees, and fault trees), SSI and structure models, and piping models, was developed and used in assessing the seismic risk of the Zion nuclear power plant (FSAR). The simplified seismic risk methodology was applied to the LaSalle County Station nuclear power plant, a BWR; to further

demonstrate its applicability, and if possible, to provide a basis for comparing the seismic risk from PWRs and BWRs.

21670 **Seismic margins review of nuclear power plants: Methodology and applications.** Ravindra, M.K.; Prassinos, P.G.; Murray, R.C. (EQE, Inc., Newport Beach, CA, USA; Lawrence Livermore National Lab., CA, USA). pp 17-22 of Transactions of the 9th international conference on structural mechanics in reactor technology. Vol. M. Structural reliability - probabilistic safety assessment. Wittmann, F.H. (ed.). Rotterdam, Netherlands; Balkema (1987). (CONF-870812—).

From 9. SMIRT: international conference on structural mechanics in reactor technology; Lausanne, Switzerland (17 Aug 1987).

A methodology for performing the assessment of existing seismic margins in nuclear power plants in the United States has been developed by a USNRC funded research program at the LLNL. In this methodology, the seismic margin for a component/system or plant is measured in terms of a High Confidence Low Probability of Failure (HCLPF) capacity. The seismic capacity is excpressed in terms of the peak ground acceleration measured at the site. The HCLPF capacity may be defined as the peak ground acceleration value for which there is 5% probability of failure at 95% confidence. The methodology has been applied on a trial basis to estimate the seismic margin for Maine Yankee Atomic Power Station. This paper describes the seismic margin review methodology and discusses the insights obtained in the trial plant review of Maine Yankee.

21671 **Seismic margin reviews of nuclear power plants: Identification of important functions and systems.** Prassinos, P.G.; Moore, D.L.; Amico, P.J. (Lawrence Livermore National Lab., CA, USA; Energy International, Inc., Kent, WA, USA; Applied Risk Technology Corp., Columbia, MD, USA). pp 365-370 of Transactions of the 9th international conference on structural mechanics in reactor technology. Vol. M. Structural reliability - probabilistic safety assessment. Wittmann, F.H. (ed.). Rotterdam, Netherlands; Balkema (1987). (CONF-870812—).

From 9. SMIRT: international conference on structural mechanics in reactor technology; Lausanne, Switzerland (17 Aug 1987).

The results from the review of the seven utility-sponsored seismic PRAs plus the Zion SSMRP have been used to develop some insights regarding the importance of various systems and functions to seismic margins. By taking this information and combining it with the fragility insights we can develop some functional/systemic screening guideline for margin studies. This screening approach will greatly reduce the scope of the analysis. It is possible only to come to conclusions regarding the importance of plant systems and safety functions for PWRs, for which six plants were studied. For PWRs, it is possible to categorize plant safety functions as belonging to one of two groups, one of which is important to the assessment of seismic margins and one of which is not. The important functional group involves only two functions that must be considered for estimating seismic margin. These two functions are shutting down the nuclear reaction and providing cooling to the reactor core in the time period immediately following the seismic event (that is, the injection phase or pre-residual heat removal time period). It is possible to reasonably estimate the seismic margin of the plant by performing a study only involving the analysis of the plant systems and structure which are required in order to perform the two functions. Such analysis must include an assessment of a complete set of seismic initiating events.

21672 **Soil-structure interaction effects on containment fragilities and floor response spectra statistics.** Pires, J.; Reich, M.; Chokshi, N.C. (Brookhaven National Lab., Upton, NY, USA. Dept. of Nuclear Energy; Nuclear Regulatory Commission, Washington, DC, USA. Office of Nuclear Reactor Regulation). pp 447-452 of Transactions of the 9th international conference on structural mechanics in reactor technology. Vol. M. Structural reliability - probabilistic safety assessment. Wittmann, F.H. (ed.). Rotterdam, Netherlands; Balkema (1987). (CONF-870812—).

From 9. SMIRT: international conference on structural mechanics in reactor technology; Lausanne, Switzerland (17 Aug 1987).

Structural fragilities for reinforced concrete containment obtained with the BNL method show that the soil-structure interaction increases the median and range of the structural fragility. Computation of floor response spectra statistics for the example structure have shown that the mean and coefficient of variation of the floor response spectra ordinates are markedly affected by the interaction effect.

21673 **(DPST—85-239-Rev.1-Del.Ver.) Derivation of the assembly deposited power ratio for use in ECS analyses.** Parks, P.B.; Graves, W.E. (Savannah River Lab., Aiken, SC (USA)). 9 Oct 1985. Contract AC09-76SR00001. 36p. NTIS, PC A03. Order Number DE88005582/JAW.

During the last three years, the methodology for computing the power deposited in an assembly after nuclear shutdown was developed and reported. In the most recent development a derivation of the "shutdown power ratio" was given. That ratio was defined as the ratio of the assembly sensible power at time t after shutdown to the assembly sensible power just before shutdown, excluding moderator to coolant heat transfer. The assembly power after shutdown (excluding the moderator to coolant heat transfer) consists of components due to delayed neutron fission and fission product decay. Both of these sources of energy must be taken into account when computing ECS power limits. Recently, an error was discovered in the equation which defined the shutdown power. The kinetic energy carried by the fast neutrons born during fission was incorrectly treated as being deposited in the assembly. In fact, practically all of the neutron kinetic energy is delivered to the moderator. Fission product decay powers for the Mark 16B, Mark 22, Mark 31A and Mark 31B assemblies were taken from decay heat tables when calculating the shutdown power ratios. However, the accuracy of these decay heats is suspect, due to an unverified extrapolation to short cooling times of the "energy redistribution factors" which were used as input data for the HMTABLE code which prepared the tables. A new set of conservative decay heats appropriate for shot cooling times has been reported. This set is now the source for the Mark 16B-31 and Mark 22 values of the decay heats used in this document. Because of these considerations, a reevaluation has been made of power deposited after shutdown in Mark 16B, Mark 31, and Mark 22 assemblies.

25 ENERGY STORAGE

2506 Thermal

REFER ALSO TO CITATION(S) 21361

21674 **(NEDO—OS-8605) Research and development of super heat pump energy accumulation systems. Fiscal 1985.** (New Energy Development Organization, Tokyo (Japan)). Apr 1986. 195p. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88770051/JAW.

This report describes studies made by the New Energy Development Organization in an effort to develop and effective energy-saving system that consists of a super heat pump (SHP) and heat storage system. In particular, these studies are focused on compressor-driven SHP's and chemical heat storage (CS) technology. These systems can serve for effective utilization of nighttime reduced-rate power if applied to air-conditioning in business offices. A CS is especially useful for saving energy under varying conditions. A centralized type and a distributed type are considered in applying these systems to district air conditioning and hot water supplies. A SHP system can work effectively for such industrial processes as load leveling of electricity, and can be competitive with existing boiler systems if used in the most suitable temperature rise range. Thus, it is insisted that energy can be saved substantially by using such new SHP heat accumulation systems. Compared to water storage tanks, chemical heat storage tanks are generally smaller in size. In district air conditioning and hot water supply systems, the costs for laying pipelines for heat transport may account for a large portion of the total construction costs. Electric power is

consumed mainly for air conditioning and industrial cooling processes in summer and for lighting and heating in winter. (93 figs, 40 tabs)

2508 Chemical

REFER ALSO TO CITATION(S) 21674

21675 (NEDOJ—8702, pp 398-423) **Study on super heat pump energy storage system.** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770076/JAW.

In FY 1986 NEDO annual report (Part 2).

For development of a super heat pump energy storage system, the units of a super compression heat pump, and a chemical heat storage were investigated. An optimum total system was developed, based on the results, and was operated. The super heat pump energy storage system was applied for two buildings in two modes, and for a 5,000 apartment complex in two modes. The SHP capacity, the power leveling effect, and the running cost were determined. For the system applied for industrial process heating, the energy efficiency, the utility consumption, and the load leveling effect were determined, followed by evaluation and selection of an optimum energy storage system for the total system. (16 figs, 3 tabs)

2509 Batteries

REFER ALSO TO CITATION(S) 21942, 21942, 21943, 22095

21676 **(EPRI-AP—5575) Development of Beta Batteries for utility application: Final report.** (General Electric Co., Philadelphia, PA (USA). Advanced Energy Programs Dept.). Jan 1988. 246p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920191/JAW.

This report summarizes the work performed by the General Electric Co. on sodium-sulfur battery related technology since the inception of GE's involvement at the Corporate Research and Development Center in 1966. It represents GE's Final Report to the Electric Power Research Institute in compliance of the EPRI-GE Program - Development of Beta Batteries for Utility Application, Project No. 128-7. The report documents the fundamental technology development performed by GE-CRD on beta"-alumina synthesis, forming of electrolyte via electrophoretic deposition, sulfur electrode materials characterization and design, sodium electrode materials characterization and design, sulfur container materials characterization and process development and electrolyte seal development. The report evolves this fundamental technology discussion into the development of the sodium-sulfur cell as the Program transitioned from the CRD laboratories to an Operating Component - Energy Systems Department and eventaully Advanced Energy Programs Department. The report addresses the GE utility cell - the FII - in regards to its design, manufacturing, and performance. Also, the design of a 100 MWh utility load levelling battery utilizing the FII cell is presented. Recommendations for future development and design activities are proposed throughout the report. 75 figs., 38 tabs.

21677 **(EPRI-AP—5576) Development of Beta Batteries for utility application: Progress update: Interim report.** (General Electric Co., Philadelphia, PA (USA). Advanced Energy Programs Dept.). Jan 1988. 168p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920190/JAW.

The interim results of an EPRI-sponsored program to develop sodium sulfur batteries are presented in this report. The report period is July 1981 through December 1982. Program ojectives during this period have been to improve the reliability and performance characteristics of the cell. Improvements were measured using the General Electric-Chloride Silent Power Limited Program (CSPL) NaS7 165 Ahr cell. A group of cells on test at the end of the report period had projected lifetimes of over 2500 cycles, exceeding a goal of 1500 cycles. This same group of cells had an average resistance rise of 0.35 mohms after 500 cycles, almost a factor of ten better than the program objective of less than 3 milliohms after 500 cycles. These cells also met or exceeded the program objectives for capacity retention and cell efficiency. Fabrication and testing of a new 650 Ahr electric utility energy storage cell was undertaken. Safety testing of this cell was initiated and after introduction of safety features, the cell met the program safety objectives. In the area of cell component development the root causes of two major cell performance problems that had previously limited cell operation, asymmetric polarization and resistance rise with cell age, are now understood and the causes eliminated. A new electrolyte beta" composition based on General Electric's model of the electrolyte material has been identified and reduced to practice. This electrolyte has approximately one-half the electrical resistivity of the material in use at the start of this report period.

21678 **(NEDO-P—8623) Feasibility study on deversified fuels for molten carbonate fuel cell (Part 2).** (New Energy Development Organization, Tokyo (Japan)). Mar 1987. 145p. (In Japanese). NTIS (US Sales Only), PC A07. Order Number DE88770068/JAW.

The reforming technology of fuel for molten carbonate fuel cell, power generating system by fuels, characteristics of cell and manufacturing cost of fuel gas were investigated. The partial oxidation method was used for reforming the fuel. The gasification principle, the comparison of the method with steam reforming and the adaptability of it to the molten carbonate fuel cell were examined. The power generating efficiency of a 100MW-plant was calculated using three fuels, natural gas, LPG and methanol, for two types, internal and external, reforming methods. Both efficiencies using methanol for the external reforming method and using natural gas for the internal reforming method are higher. The V-I characteristics of eight types of three through ten layer-built cells comprised of a single cell with area of 100 to 3600 cm^2 were examined using natural gas. The voltages under the standard conditions of two cells among the eight ones are 851.8 and 743.6 mV, respectively, which are higher than the target value. The manufacturing cost of fuel gas from methanol is almost the same as that from LPG because the construction cost of equipment for methanol is low though the unit price of fuel is high. (49 figs, 67 tabs)

21679 (NEDOJ—8603, pp vp) **Development of a 10 KW (80 KWh) zinc-chlorine battery for electric power storage using solvent absorption chlorine storage system.** Horie, T.; Ogino, H.; Fujiwara, K.; Watakabe, Y.; Hiramatsu, T.; Kondo, S. (The Furukawa Electric Co., Ltd., Tokyo, Japan; The Furukawa Battery Co., Ltd., Yokohama, Japan; New Energy Development Organization, Tokyo, Japan). 1986. New Energy Development Organization, Tokyo, Japan.

In FY 1986 NEDO Technical Report.

After the trial fabrication of a zinc-chlorine energy storage battery in 1984, its improved version was developed in 1985. The major technical problems concerning zinc-chlorine batteries are how to improve the property of the electrodes in order to quicken reaction, minimize the energy needed for storage by achieving safe chlorine storage, and improve the battery structure in order to simplify assembly and raise the reliability. To serve these purposes, the improved version employs larger electrodes and support frames, a scheme for increasing the energy efficiency, and a new chlorine storage method. The new chlorine storage method is based on the use of a solvent. Using this method, the energy needed for chlorine storage and supply has been reduced to about one-third of the energy needed with the conventional hydrate method. As a result of the improvements, the total efficiency has been increased by 10% and the battery volume has been reduced by 60% when compared with the original version. (11 figs, 4 tabs)

21680 (NEDOJ—8603, pp vp) **Improvement of 300 Ah Na-S cell production.** Kita, Akira; Takashima, Koichiro; Nomura, Eiichi; Matsui, Kazumasa; Kagawa, Hiroshi. (Yuasa Battery Co., Ltd., Takatsuki, Japan). 1986. New Energy Development Organization, Tokyo, Japan.

In FY 1986 NEDO Technical Report.

This study was conducted under commission from NEDO. The feasibility of energy storage systems based on 10 kW (80 kWh) sodium-sulphur batteries is under investigation. As part of the investigation activities, study was conducted to improve the battery

production method and improve the design of 300 Ah cells making up the battery. Three production runs were performed. At the first run, the rate of defective cells was 20%. The primary reasons why the cells were regarded as defective were insufficient capacity, cracks on the beta alumina tubes, and seal leakage. Insufficient capacity was caused by improper design of the positive electrode matrix; beta alumina tube cracks were mainly by an insufficient strength of the tube and an unsatisfactory structure of the thermo-compression seal; seal leakage was caused by unsatisfactory welding and thermo-compression. Efforts were paid to eliminate these causes. As a result, the rate of defective cells at the third production run was reduced to about 4%. However, defects due to beta alumina tube cracks were not reduced. (6 figs)

21681 (NEDOJ—8603, pp vp) **Testing of a 10 kw/ 80 kwh Na-S battery for utility load Leveling.** Kita, Akira; Takashima, Koichiro; Nomura, Eiichi; Matsui, Kazumasa; Kagawa, Hiroshi. (Yuasa Battery Co., Ltd., Takatsuki, Japan). 1986. New Energy Development Organization, Tokyo, Japan.

In FY 1986 NEDO Technical Report.

This study was conducted under commission from NEDO. A 10 kW (80 kWh) sodium-sulphur battery is being developed to investigate the feasibility of an energy storage system based on a sodium-sulphur battery for utility load leveling. The cell configuration of the test-fabricated battery is as follows: Seven cells are connected in series into a string; eight strings are connected in parallel into a submodule; four submodules are connected in series. This configuration has proved to assure a high reliability of overall battery operation even when individual cells suffer from capacity variations or failure. The battery temperature was controlled by starting and stopping the heater provided to maintain battery operation according to the status of the battery – i.e., charging, discharging, or standing. As a result, the total energy efficiency was calculated to be about 75% when the power for the heater and fan was taken into consideration. (5 figs)

21682 (NEDOJ—8603, pp vp) **80 kwh zinc bromide battery for electric power storage.** Fujii, T.; Fushimi, K.; Hashimoto, T.; Kumai, Y.; Hirota, A.; Ito, H.; Jinnai, K.; Kishimoto, Y.; Kanzashi, M. (Meidensha Electric Mfg. Co., Ltd., Tokyo, Japan). 1986. New Energy Development Organization, Tokyo, Japan.

In FY 1986 NEDO Technical Report.

As one of the advanced types of batteries, Meidensha has been developing a circulating electrolyte type zinc bromide battery. Further to the features of advanced batteries such as abundant availability of the materials, high density of energy and power, this type characterizes the following points: an aqueous electrolyte battery with easy maintenance and control at normal temperature, carbon-plastic electrode which is suited for mass production at low cost for large capacity applications, and compact construction on simple battery for easy assembling. Starting with a 1 kW class battery tested in 1983, with a good result of 80% energy efficiency for example, it was then scaled up tenfold, and a 10 kW (80 kWh) battery was produced. To solve many problems before the commercialization, the 2nd and the 3rd improved 10 kW class batteries have been constructed recently, and continued efforts are made for the improvement. (10 figs, 1 tab)

21683 (NEDOJ—8603, pp vp) **Development of sodium-sulfur batteries for utility load leveling.** Kita, Akira; Takashima, Koichiro; Nomura, Eiichi; Matsui, Kazumasa; Kagawa, Hiroshi; Matsuo, Yasushi; Iijima, Shigeru. (Yuasa Battery Co., Ltd., Takatsuki, Japan; NGK Spark Plug Co., Ltd., Komaki, Japan). 1986. New Energy Development Organization, Tokyo, Japan.

In FY 1986 NEDO Technical Report.

The sodium-sulfur batteries for utility load leveling are being developed by Yuasa Battery Co. with the aid of NGK Spark Plug Co. Following the first successful battery of 1kW/8kWh class, a 10kW/80kWh battery is being developed, composed of 224 pieces of 300 Ah cell cased in thermal insulating enclosure. A prototype of the same scale has shown a Wh efficiency of about 82%. An improved type of same scale, developed recently, shows the efficiency of approximately 83%, with a total energy efficiency of approximately 79%. This result has been achieved through such several points as a newly designed thermal insulation casing, and an improved electrode, etc.. By minimizing the thermal loss, they allow a same type of cell-temperature increase as in the previous batteries, while keeping the heated cell at a comparatively constant temperature even after the heater is powered off. (19 figs, 13 photos)

21684 (NEDOJ—8702, pp 343-361) **Development of advanced battery power storage system.** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770076/JAW.

In FY 1986 NEDO annual report (Part 2).

The purpose of this study is to develop an advanced high-efficient, large capacity battery and the technology of a power storage system for connecting to the network. The study was initiated in 1980. The final goal is to commercialize the system by 1991 based on the demonstration test of a 8 MWh-plant. Advanced 10 KW- Nos.3 and 4 battery units of four types, sodium-sulphur, zince-chlorine, zinc-bromine and redox flow, were manufactured and the secondary interim evaluation tests of these units were successfully made. A 1MW demonstration plant for development of system technology was constructed in the site of Tatsumi Substation of Kansai Electric Power Co. and the basic performance such as power conversion efficiency, performance of steady-state operation and response time of the system have been tested since October. The economics and installation cost of the power storage system by battery were investigated. (3 tabs, 4 photos)

21685 **(PB—88-856034/XAB) Lead batteries. December 1981-December 1987 (citations from the NTIS data base). Report for December 1981-December 1987.** (National Technical Information Service, Springfield, VA (USA)). Jan 1988. 121p. NTIS PC N01/MF N01.

Supersedes PB—87-852349.

This bibliography contains citations concerning research and development, and applications of lead batteries. Topics include performance evaluations of specific batteries, manufacture and design aspects, and electrochemical studies. Although a variety of applications are presented, most are in conjunction with electric-vehicle propulsion and electric-utility load-leveling studies. Environmental effects and occupational health hazards associated with lead battery manufacture and use are also discussed. (This updated bibliography contains 246 citations, 10 of which are new entries to the previous edition.)

21686 **(UCRL—21018-Vol.1) Aluminum-air battery development: Final report.** (ELTECH Systems Corp., Fairport Harbor, OH (USA). Research and Development Center). 20 Nov 1987. Contract W-7405-ENG-48. 223p. NTIS, PC A10/MF A01; 1; GPO Dep. Order Number DE88006620/JAW.

This volume covers air cathode development. (DLC)

21687 **(UCRL—21018-Vol.2) Aluminum-air battery development: Final report.** (ELTECH Systems Corp., Fairport Harbor, OH (USA). Research and Development Center). 20 Nov 1987. Contract W-7405-ENG-48. 288p. NTIS, PC A13/MF A01; 1; GPO Dep. Order Number DE88006621/JAW.

This volume covers Al-air battery/system engineering. (DLC)

21688 **(UCRL—21018-Vol.3) Aluminum-air battery development: Final report.** (ELTECH Systems Corp., Fairport Harbor, OH (USA). Research and Development Center). 20 Nov 1987. Contract W-7405-ENG-48. 137p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88006617/JAW.

This document reports on the design and testing of aluminum anodes for aluminum-air batteries. (JDH)

21689 **(UCRL—21018-Vol.4) Aluminum-air battery development: Final report.** (ELTECH Systems Corp., Fairport Harbor, OH (USA). Research and Development Center). 20 Nov 1987. Contract W-7405-ENG-48. 242p. NTIS, PC A11/MF A01; 1; GPO Dep. Order Number DE88006618/JAW.

This paper presents the results of investigations of the performance of aluminum-air battery electrodes. Different electrodes were built and tested, and their performance measured. The authors conclude that the present component development has been successful, and that future research be aimed at system integration. (JDH)

29 ENERGY PLANNING AND POLICY

21690 (NEDOJ—8702, pp 202-206) **Study on photovoltaic power systems. Development of dispersed stand-alone system (methane gas hybrid system).** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770076/JAW.

In FY 1986 NEDO annual report (Part 2).

For feeding domestic animals in the existing distribution terminal rearranged districts development of a power generation system using solar energy and methane gas generation was made in FY 1986. For the inclination solar flux at 3.25 kWh/m² day, the generated energy was 48.15 kWh/day, and the solar energy utilization ratio was relatively low, that is, 49% (the solar cells; 30.24 kWp, and the theoretical value; 98.2 kWh/day). This is due to the lower load by 30%, and an unbalance of the solar cells with the electric batteries. The battery charge by solar energy and methane gas power generation was 47.48 kWh/day, and the discharge was 34.24 kWh/day. The balance was suitable, that is, 72%. The number of fed pigs was 700, the facal quantity 1.70 ton/day, and the methane gas generation 30.8 m³/ton, as planned. When the voltage of the solar cell array was detected to be lower than that of the battery voltage, the methane gas power generation plant was stopped. This contributed to the enhanced power generation by 1.8 times. (2 figs, 5 tabs)

2901 Energy Analysis And Modeling

REFER ALSO TO CITATION(S) 20885, 20886, 20887, 21108, 21728, 21895

21691 (EUR—11038, pp 41-62) **Energy outlook for oil-exporting and oil-importing developing countries.** Faraj, S.H.; Miremady, A. 1987. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88920165/JAW. (CONF-8703233—).

From EC/OAPEC/OPEC seminar; Luxembourg, Luxembourg (17 Mar 1987).

The special nature of the developing countries' economies which are characterized commonly by the low industrial base, the predominant agricultural sector, the high rate of non-commercial energy utilization, and the extreme sensitivity towards international developments necessitates a distinction in the approach used in the assessment of the energy outlook of these countries. Financial, economical, social, and organizational problems appear to be more interactive than technical problems in the assessment of the energy strategies of these countries. The outlook presented in this paper gives due consideration to the implication of these factors on the economic and energy situations of these countries during the period under consideration. The increase in demand for energy and oil, although moderate, is expected to be about 50% (10 mboe/d) and 39% (4.5 mboe/d) over the 1984 level by the year 2000, respectively. In spite of the clear difference between the growth in energy and oil consumption, the latter would continue to dominate the energy scene in these countries with over 53% share in the total energy mix, by the end of the period. The outlook for energy supply is foreseen to continue to be comfortable. 2 references, 6 figures, 12 tables.

21692 **(PB—88-139506/XAB) Systems approach to energy quality and efficiency.** Patterson, M.G. (Massey Univ., Palmerston North (New Zealand). Food Technology Research Centre). Jun 1987. 165p. NTIS, PC E07/MF A01.

This study is concerned with establishing an operational definition of energy efficiency in complex real-world systems, in order to provide a basis for resolving the energy-quality problem. Complex systems are characterized as having multiple inputs, outputs and feedbacks of energy. The origins and nature of the energy-quality problem are discussed in relation to the development of the modern discipline of Energy Analysis. The proposed methodology is based on mathematically defining a reference system or economy by constructing a set of simultaneous linear equations. The methodology is applied to the New Zealand situation, using the 1984 economy and a hypothetical energy-efficient economy, as the reference systems. From the analysis emerged some direct policy implications in terms of energy efficiency. Applications of the methodology for policy analysis, assessment of energy-conservation options, and other uses are outlined.

2902 Economics And Sociology

REFER ALSO TO CITATION(S) 20747, 20975, 20976, 20977, 20978, 20982, 21000, 21363, 21707, 21708, 21709, 21728, 21734, 21735, 21742, 21748, 21907, 21922, 23936

21693 **(ENERGY/SEM—7/AC/2) Preparatory meeting for the symposium on the optimum use of primary energy resources in final heat consumption.** (United Nations, Geneva (Switzerland). Economic Commission for Europe). 30 Nov 1987. 6p. (CONF-8711155—Summ.). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88900384/JAW.

From Preparatory meeting for the symposium on the optimum use of primary energy resources in final heat consumption; Prague, Czechoslovakia (10 Nov 1987).

This paper consists of the minutes of a meeting held to prepare for a symposium on energy use. (JDH)

21694 **(PB—88-144142/XAB) Preservation of the Declaration of Independence and the Constitution of the United States. Final report.** (National Bureau of Standards, Washington, DC (USA)). 2 Jul 1951. 21p. (NBS-CIRC—505). NTIS, PC A03/MF A01.

Also available from Supt. of Docs.

At the request of the Librarian of Congress, an investigation was undertaken by the National Bureau of Standards to determine the best means of preserving the original copies of the Declaration of Independence and the Constitution of the United States. Consideration was given to three aspects of the problem. (1) Preservation of the documents in an inert atmosphere. (2) Filter to protect against harmful radiation. (3) Lighting conditions to improve viewing of the documents. The report summarizes the investigation on the first two subjects. The third subject will be discussed in a separate report.

2903 Environment, Health, And Safety

REFER ALSO TO CITATION(S) 21025, 21059, 21064, 21065, 21069, 21089, 21120, 21710, 21727, 22273, 22355, 22588, 22640, 22651, 22662, 22667, 22668, 22752, 22757, 22764, 22795, 22796, 22797, 22798, 22799, 22800, 22801, 22802, 22820, 22821, 22822, 22823, 22824, 22825, 22828, 22832, 22863, 22864, 22865, 22866, 22867, 22868, 22869, 22870, 22871, 22872, 22873, 22874, 22877, 22978, 22991, 23154, 23222

21695 **(AD-A—186894/2/XAB) Consolidation of environmental planning, bioenvironmental engineering, and base safety into a single resource protection organization. Master's thesis.** Ridder, D.M. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Systems and Logistics). Sep 1987. 91p. (AFIT/GEM/DEM—87S-21). NTIS, PC A05/MF A01.

This study investigated how the U.S. Air Force may be able to establish a more effective control over the management of environmental quality, and human health and safety programs. The premise for this study was that consolidating Environmental Planning, Bioenvironmental Engineering, and Base Safety into a single Resource Protection organization may achieve a more effective control of the management of environmental quality, and human health and safety programs. The study found, from the analysis of

the functional responsibilities currently being performed by the three organizations, that consolidating the three organizations could achieve a greater coordinated effort in the accomplishment of Air Force environmental quality, and occupational health and safety programs. This study accomplishes three additional objectives. First, the Resource Protection organization was structured in a matrix organizational design; allowing more flexibility for assigning personnel from different branches to the same high priority project. Second, the Resource Protection organization was positioned directly under the command of the senior installation commander; facilitating a higher level of decision making support for environmental compliance matters. Finally, the Resource Protection organization would obtain the delegated authority commensurate with the responsibility of enforcement of environmental laws and regulations.

21696 **(AD-A—186983/3/XAB) Consolidation of environmental planning, bioenvironmental engineering, and base safety into a single resource protection organization. Masters's thesis.** Ridder, D.M. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Systems and Logistics). Sep 1987. 92p. (AFIT/GEM/DEM—87S-21). NTIS, PC A05/MF A01.

This study investigated how the U.S. Air Force may be able to establish a more-effective control over the management of environment quality and human health and safety programs. The premise for this study was that consolidating Environmental Planning, Bioenvironmental Engineering, and Base Safety into a single Resource Protection organization may achieve a more effective control over the management of these programs. This study was conducted to determine how these organizations could be consolidated in terms of organizational structure, functional responsibilities, and what effect the reorganization might have on the management of the programs.

21697 **(IIUG/dp—87-1) Improving environmental quality through structural change. A survey of thirty-one countries.** Jaenicke, M.; Moench, H.; Ranneberg, T.; Simonis, U.E. (Wissenschaftszentrum Berlin (Germany, F.R.). Internationales Inst. fuer Umwelt und Gesellschaft). 1987. 53p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88752012/JAW.

Using a small set of indicators, thirty-one western and eastern industrialized countries are being tested with regard to the levels of environmental pollution and economic structure. The authors come to the conclusion that the close connection between economic prosperity and environmental pollution, unequivocal in 1973, had dissapated by 1983. The de-linking of economic growth form material-intensive industrial production modes is particularly evident. In some cases 'automatic' environmental benefits (gratis effects) are generated in this way. On the whole, the development profiles of the countries investigated differ greatly. There are countries, in particular Sweden, with absolute structural improvement in the ecological sense; countries like Japan and Norway with structural improvement relative to economic growth; and countries, inclusing most eastern and southern European states, featuring no structural improvement or even negative structural environmental impacts. (orig./HSCH).

21698 **(IIUG/dp—87-3) Environmentally sensitive areas. Does E.S.A. really mean the enforced surrender of the arena?.** Wathern, P. (Wissenschaftszentrum Berlin (Germany, F.R.). Internationales Inst. fuer Umwelt und Gesellschaft). 1987. 41p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752008/JAW.

This paper contains a review of the formulation and implementation of the EC Environmentally Sensitive Area (ESA) Programme in the UK. In marked contrast to previous schemes designed to support traditional agriculture in order to achieve environmental, primarily landscape conservation, objectives, the ESA scheme is funded exclusively from within the agricultural sector. Consequently, non-environmental issues exerted an influence on the final selection of nine ESAs during 1986. In this paper it is argued that in adopting the procedures to implement this programme the Ministry of Agriculture is seeking to control an initiative which is destined to become increasingly important as agricultural policy evolves to accommodate concerns other than efficient food production. This is an area where the UK Ministry previously has had no special competence or experience.

21699 **(IIUG-pre—87-1) Environmental policies and anticipatory strategies.** Scimemi, G. (Wissenschaftszentrum Berlin (Germany, F.R.). Internationales Inst. fuer Umwelt und Gesellschaft). 1987. 34p. Wissenschaftszentrum Berlin fuer Sozialforschung g.G.m.b.H. (WZB), Germany, F.R. Internationales Inst. fuer Umwelt und Gesellschaft.

The author first introduces a precise working definition of the term anticipatory policy. On this basis, certain characteristics of anticipatory policy are then described, including advantages and limitations. The role of three elements of anticipatory policy is analysed in more detail, i.e. of technical rationality, political viability, and demonstrable evidence. The author then identifies and elaborates upon various courses of action with which decision-makers may try to implement anticipatory strategies of environmental policy. (orig./HSCH).

21700 **(IIUG-pre—87-4) Soviet management of biosphere resources.** Pryde, P.R. (Wissenschaftszentrum Berlin (Germany, F.R.). Internationales Inst. fuer Umwelt und Gesellschaft; San Diego State Univ., CA (USA)). 1987. 26p. Wissenschaftszentrum Berlin fuer Sozialforschung g.G.m.b.H. (WZB), Germany, F.R. Internationales Inst. fuer Umwelt und Gesellschaft.

A detailed overview is given of the environmental problems in the fields of soil protection, nature protection, water and air pollution control, and environmental monitoring, problems which the Soviet Union has to overcome in the 1990s. The author also deals with the international activities of the Soviet Union in the environmental field. His conclusion is that only through a major reallocation of investment funds and a change in the national priorities can a further deterioration of the environment be prevented. (orig./HSCH).

21701 **(IIUG-pre—87-7) Preventive environmental policy and environmental law.** Rehbinder, E. (Wissenschaftszentrum Berlin (Germany, F.R.). Internationales Inst. fuer Umwelt und Gesellschaft; Frankfurt Univ. (Germany, F.R.)). 1987. 20p. (In German). Wissenschaftszentrum Berlin fuer Sozialforschung g.G.m.b.H. (WZB), Germany, F.R. Internationales Inst. fuer Umwelt und Gesellschaft.

The prevention principle applies to content, direction and intensity of environment protection and can therefore be interpreted as being the central theme of environmental policy. This paper analyzes the prevention principle as one of environmental law and environmental policy. In environmental law it appears in two ways: As a form of rules of law principle and as a structural principle, each clearly defined. In environmental policy, however, the prevention principle is still quite vague. The author describes the further possibilities of the prevention principle and its requirements for successful implementation.

21702 **(IIUG-rep—87-2) Forest damage report 1986: An analysis of press coverage.** Espe, H. (Wissenschaftszentrum Berlin (Germany, F.R.). Internationales Inst. fuer Umwelt und Gesellschaft). 1987. 155p. (In German). NTIS (US Sales Only), PC A08. Order Number DE88752011/JAW.

In this study the press coverage of the Forest Damage Report 1986, published on November 5, 1986, is analyzed. All in all, the press coverage can be assessed as follows: The Forest Damage Report 1986 was treated by the German press as a current event of moderate importance. Local and national daily newspapers reported and commented, in the majority of cases critically. Weekly newspapers and magazines did not report. In view of the great importance of the issue of forest damage, the question remains whether or not such press coverage is sufficient as a source of information for the public, and to assist in planning and implementing measures to abate further forest damage. (orig./HSCH).

21703 **(ORNL—6405/R4) Environmental regulatory update table, September 1987.** Langston, M.E.; Sharples, F.E.; Tucker, C.S. (Oak Ridge National Lab., TN (USA)). Oct 1987. Contract AC05-84OR21400. 107p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88003696/JAW.

This report provides information on regulatory initiatives of interest to DOE operations and contractor staff with environmental management responsibilities. The table is updated each month with information from the Federal Register and other sources, including direct contact with regulatory agencies. Each table entry provides a chronological record of the rulemaking process for that initiative with an abstract and a projection of further action.

21704 **(PB—88-142385/XAB) Disposal of toxic wastes.** (International Council of Scientific Unions, Paris (France)). 4 Aug 1987. 17p. (GEN—4/8.27/87). NTIS, PC E03/MF A01.

A Special Committee on Toxic Waste Disposal (TOWD) was established by the ICSU General Assembly in 1984 to look into the origin and disposal of toxic wastes, the effects that needed to be guarded against, and the research needed to ensure that the disposal would produce minimum risk to the environment and human health. The Committee began its work in 1985 and met on two occasions, in May and November of 1985. From these discussions came a preliminary draft report that was circulated to all members of the Committee, returned to the ICSU Secretariat where it was put into final draft form, again circulated to members of the Committee for their comments and was finally sent to members of the ICSU family. It was discussed at a meeting of the General Committee and at the General Assembly in September 1986 and the report now reflects all comments received including those from Dr. J.A. Gilliland, National Hydrology Research Institute, Saskatoon, Canada, to whom the Chairman sent a copy.

21705 **(PB—88-143169/XAB) Peer review and credibility in TVA (Tennessee Valley Authority) environmental research and development.** (National Research Council, Washington, DC (USA)). 1986. 51p. NTIS, PC A04/MF A01.

This report examines the Tennessee Valley Authority's (TVA) current approach to peer review of its environmental research and provides advice on how these practices, as well as other means to enhance the quality of environmental research, could be improved. The committee recommends that a policy outlining a procedure for peer review be established, that a board be established to oversee the agency's research program, that a group of scientists be designated to coordinate the review process, and that scientists be encouraged to publish in the open literature.

2904 Natural Resources

REFER ALSO TO CITATION(S) 21120, 22820

21706 **(NZERDC—144) An optimisation model of the New Zealand Agro-food system.** Patterson, M.G. (Massey Univ., Palmerston North (New Zealand). Food Technology Research Centre). Jun 1987. 68p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88900358/JAW.

This report provides a brief outline of MASIM (Massey Agro-Food System Input-Output Model), up to its current state of development. MASIM is a large scale Input-Output based optimization model of the New Zealand agro-food sector, although the model can also be used for simulation purposes. MASIM differs from conventional Input-Output models in that it describes the flow of inputs and outputs through the agro-food sector in both physical and economic value terms. The initial applications of MASIM focused on energy optimization problems, related to achieving nutritional goals. These runs emphasized the biophysical constraints to food production, particularly land-use and energy constraints. The future application of MASIM, beyond its initial focus, is discussed. MASIM is considered to be a particularly valuable tool for evaluating development and marketing options for the agro-food sector. MASIM can relate production and processing possibilities to market demands in an integrated fashion; incorporating labor, land-use, technological and policy orientated constraints. MASIM's potential role in scenario investigations is also discussed. Means of improving the quality of data used by the model are described. Recommendations are made about the future development and application of MASIM. 149 refs., 6 figs., 2 tabs.

21707 **(PB—88-142526/XAB) Seabed material commodity and resource summaries. Technical report.** Hoagland, P.; Broadus, J.M. (Woods Hole Oceanographic Institution, MA (USA)). Oct 1987. 242p. (WHOI—87-43). NTIS, PC A11/MF A01.

This report results from concentrated research conducted by a research team under the primary sponsorship of the National Sea Grant College Program. The report provides background documentation for the recent publication: J. M. Broadus, 1987, Seabed materials, Science 235(4791):853-860. It is organized to lead the user directly to sources that may provide further information on particular seabed materials. Several presentations of data in the report are of use in understanding the fundamentals of marine mineral markets including: descriptions of the size of the marine mineral resource base and the size of the markets for onshore and offshore sources of marine minerals; price series for minerals with prospective seabed sources; composite prices for four marine mineral types; consumption and price elasticities of mineral reserves; trends in mineral exploration inputs and U.S. federal government expenditures for marine nonfuel resources; maps of existing, proposed, or past entitlements for marine hard minerals; a list of known marine polymetallic sulfide (MPS) deposits and reported grades; world trade flows in zinc and copper; the value of apparent consumption in the United States in relation to imports and recycling; and a bibliography.

21708 **(PB—88-145370/XAB) Report to the Congress on the use of tax deductions for donations of conservations easements.** (Department of the Treasury, Washington, DC (USA). Office of Tax Analysis). Dec 1987. 32p. NTIS, PC A03/MF A01.

This report was mandated by Congress as part of the Temporary Tax Provisions Extension Act of 1980 (P.L. 96-541). The major findings of the study are: (1) Tax deductions for easement donations will tend to be a desirable policy option; (2) There appear to be substantial difficulties involved in valuing, monitoring, and enforcing easement donations; (3) The possibility of replacing deductibility with some other policy to encourage preservation is also considered; and (4) The IRS collected and analyzed data from three years of tax returns of both donors and recipients of conservation easements.

21709 **(PB—88-146774/XAB) Commonwealth of Virginia emergency operations plan. Volume 4. Emergency management of resources.** (Virginia Office of Emergency and Energy Services, Richmond (USA)). Sep 1987. 230p. NTIS, PC A11/MF A01.

See also Volume 1, PB—83-138727.

The purpose of this document is to provide a state plan for the emergency management of resources in peace or war. To facilitate training and transition of wartime operations, the peacetime organization and concept of operations are, to the extent possible, designed to meet the wartime requirement. Because of differences in the nature of the problems in two environments, the plan is organized in two parts. Part I provides for the emergency management of resources in peacetime.

21710 **(PB—88-162631/XAB) Report to congress: wastes from the extraction and beneficiation of metallic ores, phosphate rock, asbestos, overburden from uranium mining, and oil shale. Final report.** Derkics, D. (Environmental Protection Agency, Washington, DC (USA). Office of Solid Waste). Dec 1985. 293p. (EPA—530/SW-85/033). NTIS, PC A13/MF A01.

Report to Congress on Mining Wastes presents the results of studies carried out pursuant to Sections 8002(f) and (p) of the Resource Conservation and Recovery Act of 1976, as amended. The Report provides a comprehensive assessment of possible adverse effects on human health and the environment from the disposal and

utilization of solid waste from the extraction and beneficiation of ores and minerals.

2905 Research, Development, Demonstration, And Commercialization

REFER ALSO TO CITATION(S) 20785, 21124, 21233, 21260, 21262, 21263, 21589, 21674, 21727, 21906, 21946, 21958, 23343, 23968

21711 (DOE/CE/40774—T1) Separation and purification: Critical needs and opportunities. Price, R. (ed.). (National Research Council, Washington, DC (USA). Committee on Separation Science and Technology). 1987. Contract FG01-81ER10984;FG01-85CE40774. 107p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88005655/JAW.

The importance and pervasiveness of separations throughout the US economy indicate that a federal program of generic research, of the size recommended by this committee and structured along the high-priority research frontiers identified in this report, will have significant benefits to our economic competitiveness. Although the nation is faced with a budgetary crisis of considerable magnitude, its need to address separation problems, both to meet pressing needs and to maintain international competitiveness in high-technology markets, is too great to postpone the exploitation of opportunities afforded by separation research to the indefinite future. A timely response is required if these opportunities are not to slip from our grasp.

21712 (DOE/ER—0355) Technology '87: Research and Development Laboratory Technology Transfer Program: Annual report. (USDOE, Washington, DC). Jan 1988. 113p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88003142/JAW.

An overview of technology transfer of US Department of Energy's National Laboratories is presented. Areas specifically presented are: Materials Science and Manufacturing; Analysis and Instrumentation; Energy Technology; Environment and Waste Management; Biology and Medicine; and Computers and Communication. Specific research accomplishments are discussed. (CBS)

21713 (DOE/ER—0359) 1987 review of the Basic Energy Sciences program of the Department of Energy. (USDOE Office of Energy Research, Washington, DC). Dec 1987. 63p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88005321/JAW.

The quality, adequacy, balance, and management of the basic energy sciences program of the United States Department of Energy (US DOE) is reported. The program content consists of: National User Facilities; Materials Science; Chemical Sciences, Biological Energy Research, and Carbon Dioxide Research; Engineering and Geoscience; Applied Mathematical Sciences; and Advanced Energy Projects Research. (CBS)

21714 (DOE/OR/00033—T385) Impact on education and career plans. (Oak Ridge Associated Universities, Inc., TN (USA)). Dec 1987. Contract AC05-76OR00033. 59p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88006076/JAW.

The US Department of Energy (DOE) High School Science Student Honors Program is designed to recognize high school students with superior skills in mathematics and science, to provide them with formal training and experience with advanced equipment, and to help develop scientific and technical talent in energy-related areas. This document reports on the students who participated in the 1986 summer program which was held at two DOE laboratories. The High School Student Supercomputing Honors Program was held at lawrence Livermore National Laboratory, and the High School Student Honors Research Program was held at Brookhaven National Laboratory. 11 tabs.

21715 (EGG-M—39887) Spin off businesses as mechanisms for transferring technologies. Welch, J.M. (EG and G Idaho, Inc., Idaho Falls (USA)). 1987. Contract AC07-76ID01570. 7p. (CONF-8711153—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005640/JAW.

From FLC semi annual meeting: headed for the future; Sacramento, CA, USA (3 Nov 1987).

Federal Laboratories, especially those in rural settings, have the opportunity to participate in local economic development through spin off businesses based on laboratory technologies. Quite often, it is a laboratory employee who is one of the principals in the spin off business. Transferring technology to an employee can add a degree of complexity that is not normally faced in a transfer to an external requestor. Procedures followed at the Idaho National Engineering Laboratory by one of the prime contractors there, EG & G Idaho Inc., are discussed in this article.

21716 (LBL-PUB—620) Catalog of research projects at Lawrence Berkeley Laboratory, 1988-1989. (Lawrence Berkeley Lab., CA (USA)). Nov 1987. Contract AC03-76SF00098. 119p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88004962/JAW.

This catalog has been created to aid in the transfer of technology from the Lawrence Berkeley Laboratories to potential users in industry, government, universities, and the public. It contains a brief description of each current research projects and the level of funding for this year.

21717 (NEDO-OS—8602) Research and development projects. Fiscal 1986. (New Energy Development Organization, Tokyo (Japan)). Apr 1986. 86p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88770062/JAW.

This paper presents the research and development projects of NEDO in FY1986. The basic and detailed designs of NEDOL pilot plant for bituminous coal liquefaction will be started. The pilot plant for brown coal liquefaction will be constructed and operated. The identification of ranks of coal, purification of liquefied oil and environmental protective measures will be investigated. A 7000 Nm^3/d-high calorie fuel gas producting plant by coal gasification and the combined cycle power generation using low calorie gas will be developed. An entrained flow coal gasification and hydrogen producing pilot plants will be investigated. The low-cost silicon manufacturing process and improvement of efficiency in the field of solar energy will be studied for developing the practical solar cell system. A several hundreds KW-wind power generation plant will be designed aiming at the optimum conditions. A 10 MW-geothermal power generation demonstration plant of binary system and hot dry rock will be studied. The commercialization of a phosphoric acid fuel cell will be investigated and molten carbonate fuel cell will be manufactured on an experimental basis. The study on the optimum application system of the general purpose starling engine and heat pump will be continued and the geothermal and coal resources will be further examined.

2906 Nuclear Energy

REFER ALSO TO CITATION(S) 21059, 21064, 21065, 21069, 21087, 21089, 21108, 21120, 21124, 21125, 21584, 21585, 21586, 21808, 21809, 21810, 21811, 21812, 21813, 21814, 21953, 22273, 22552

21718 (IAEA-TECDOC—433) Improvements to the IAEA's WASP-III. Proceedings of an advisory group meeting to review progress in improving the WASP-III computer model and methodology for nuclear power planning in developing countries held in Vienna, 4-7 November 1986. (International Atomic Energy Agency, Vienna (Austria)). Oct 1987. 224p. (CONF-8611222—). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88701434/JAW.

From Advisory group meeting to review progress in improving the WASP-III computer model and methodology for nuclear power planning in developing countries; Vienna, Austria (4 Nov 1986).

An Advisory Group Meeting to review progress in improving the WASP computer code and methodology was held in Vienna during November 1986. The purpose of the present report is to include the principal presentations made at the meeting as well as the conclusions and recommendations of the working groups and of the discussions. It was generally felt that WASP remains an appropriate methodology for generation expansion planning. Given the Agency's objective to promote soundly based decisions on nu-

clear constraints, there is a clear role for the Agency to continue to support WASP, to continually review developments in the electric planning methodology and to improve WASP to make it more applicable to the needs of Member States. The introduction of VALORAGUA, a hydro simulation model, developed by Electricidade de Portugal, which allows for optimal management of hydro/thermal systems for electric generation systems with large hydro components, should make WASP more useful for electric system planners. In addition, the implementation of a PC version of WASP should stimulate wider interest in system planning. A separate abstract was prepared for each of the 8 presentations. Refs, figs and tabs.

21719 (IAEA-TECDOC—433, pp 7-10) **General overview and summary.** Schenk, K.F. (International Atomic Energy Agency, Vienna, Austria. Div. of Nuclear Power). Oct 1987. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88701434/JAW. (CONF-8611222—).

From Advisory group meeting to review progress in improving the WASP-III computer model and methodology for nuclear power planning in developing countries; Vienna, Austria (4 Nov 1986).

The main activities of the IAEA in fulfilment of the recommendations of the previous Advisory Group Meeting (AGM) to review experience with WASP and its methodology is described in this paper. The conclusions and recommendations of this AGM are also summarized.

21720 **(INIS-BR—940) Northeast project/CNEN.** Alves, R.N.; Ribeiro, G.F.; Lima, J.O.V.; Dornelles, G.H.; Laborne, J.J.; Sakamoto, L.H.; Lemos Junior, O.F.; Gloria, M.B.; Barreto, P.M.C. (Comissao Nacional de Energia Nuclear de Brasil, Rio de Janeiro; Instituto de Radioprotecao e Dosimetria, Rio de Janeiro (Brazil)). (Comissao Nacional de Energia Nuclear de Brasil, Rio de Janeiro). Oct 1987. 94p. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. Order Number TI88701595/JAW.

The subprojects from the Northeast/CNEN project, that aims to disseminate the benefits of nuclear energy are described. Those subprojects are the following: food conservation, energy, health, hydric resources, mineral and agriculture, all of them have as goal to improve the socio-economical conditions of the northeast population in Brazil. (E.G.).

2908 Waste Heat Utilization

21721 **(PB—88-857545/XAB) Cogeneration: economic and technical analysis. March 1985-January 1987 (citations from the INSPEC: Information Services for the Physics and Engineering Communities data base). Report for March 1985-January 1987.** (National Technical Information Service, Springfield, VA (USA)). Feb 1988. 126p. NTIS PC N01/MF N01.

This bibliography contains citations concerning economic and technical analysis of cogeneration systems. Topics include electric-power generation, industrial cogeneration, electricity-supply industry, and fuel-cell cogeneration. Steam power station, gas-turbine and steam-turbine technology, district heating, refuse-derived fuels, environmental effects and regulations, bioenergy and solar energy conversion, waste-heat and waste-product utilization, and performance analysis are presented. (This updated bibliography contains 274 citations, none of which are new entries to the previous edition.)

21722 **(PB—88-857552/XAB) Cogeneration: economic and technical analysis. February 1987-January 1988 (citations from the INSPEC: Information Services for the Physics and Engineering Communities data base). Report for February 1987-January 1988.** (National Technical Information Service, Springfield, VA (USA)). Feb 1988. 94p. NTIS PC N01/MF N01.

Supersedes PB—87-853727.

This bibliography contains citations concerning economic and technical analysis of cogeneration systems. Topics include electric-power generation, industrial cogeneration, electricity-supply industry, and fuel-cell cogeneration. Steam power station, gas-turbine and steam-turbine technology, district heating, refuse-derived fuels, environmental effects and regulations, bioenergy and solar energy conversion, waste-heat and waste-product utilization, and performance analysis are presented. (This updated bibliography contains 210 citations, all of which are new entries to the previous edition.)

2910 Conservation

REFER ALSO TO CITATION(S) 21692, 21735, 21738, 21742, 21744, 21753, 21758, 21761, 21763, 21764, 21769, 21772, 21773, 21774, 21783, 21791, 21794, 21890, 21892, 21903, 21912, 21926

21723 (EPRI-EM—5452, pp 29.1-29.6, Section 29) **Energy conscious construction: A program for commercial construction.** Wajcs, F.F. Jr. (Northeast Utilities, Hartford, CT (USA)). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920085/JAW. (CONF-870642—).

From 3. national conference on utility demand-side management programs: DSM strategies in transition; Houston, TX, USA (16 Jun 1987).

To promote conservation and load management, Northeast Utilities (NU) announced a new series of programs called Energy Alliance. Energy Alliance is what it says - a new and closer partnership between NU and the customers. The alliance was built upon the highly successful NU 80s/90s programs and added new programs to work with the commercial sector. The Energy Conscious Construction (ECC) program is one of the cornerstones. This presentation describes our efforts to develop and implement ECC, reviews our first six months' experience, and relates our ideas for the future.

21724 (EPRI-EM—5452, pp 32.1-32.10, Section 32) **Evaluation of a shared savings approach: The Residential Energy Conservation Action Program.** Brown, M.A. (Oak Ridge National Lab., TN (USA)). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920085/JAW. (CONF-870642—).

From 3. national conference on utility demand-side management programs: DSM strategies in transition; Houston, TX, USA (16 Jun 1987).

This paper evaluates another approach to shared savings - the Residential Energy Conservation Action Program (RECAP). RECAP is administered by the General Public Utilities Corporation (GPU), through contracts with Energy Services Companys (ESCOs). These contractors install energy retrofit measures in homes of all-electric GPU customers and are repaid by the utility - not for the cost of these measures, but for the value of the marginal avoided cost for each kWh saved due to the improvements. This paper evaluates RECAP by documenting its levels of participation, energy savings, customer satisfaction, comfort benefits, and program impacts on fuel switching and load control. Since RECAP has been offered to thousands of households by three different contractors in four New Jersey and Pennsylvania communities, attention is also given to those household, community, and program characteristics which correlate with successful implementation. Variations across contractors and communities allow judgments to be made about basic program design features that should be relevant to other residential conservation programs as well. 7 refs., 1 fig., 1 tab.

21725 (EPRI-EM—5452, pp 38.1-38.10, Section 38) **Energy and economic savings from national appliance efficiency standards.** Geller, H.S. (American Council for an Energy-Efficient Economy, Washington, DC (USA)). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920085/JAW. (CONF-870642—).

From 3. national conference on utility demand-side management programs: DSM strategies in transition; Houston, TX, USA (16 Jun 1987).

In March 1987, President Reagan signed into law the National Appliance Energy Conservation Act. The Act contains minimum efficiency standards for residential appliances and HVAC equipment (hereafter referred to as appliances). The standards rep-

resent a compromise agreed to by conservation advocates and appliance manufacturers, breaking a ten-year deadlock over national appliance standards. The standards legislation was supported by a broad coalition of over 40 national organizations including the Edison Electric Institute. The appliance standards are relatively stringent. For most products, 70 to 90% of the models offered or produced in 1986 won't qualify to be sold when the standards take effect. Consequently, the standards will have a significant impact on residential energy consumption in the future. The energy savings resulting from standards will need to be taken into account as utilities forecast load growth, plan supply-side investments, and plan demand-side management (DSM) efforts. This paper summarizes the energy and economic impacts that can be expected from the standards from both the utility and the consumer perspectives. The effect that the standards could have on other utility DSM efforts is also discussed. 7 refs., 5 tabs.

21726 (EPRI-EM—5452, pp 59.1-59.9, Section 59) **A conservation marketing success story.** Kaplon, S.S.; Oliver, T.V. (Pacific Power and Light Co., Portland, OR (USA); Bonneville Power Administration, Portland, OR (USA)). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920085/JAW. (CONF-870642—).

From 3. national conference on utility demand-side management programs: DSM strategies in transition; Houston, TX, USA (16 Jun 1987).

The Hood River Conservation Project (Project) is a research and development effort designed to identify and systematically document the effects and retrofit potential of conservation when rapidly implemented within a limited geographic area. This report will analyze the effect and impact of using a combination of incentives and marketing factors to achieve program goals. The utilization of these marketing efforts allowed the Project to obtain phenomenal participation levels. This report presents an analysis of how the elements of the "marketing mix" - product, price, place, and promotion - were used to obtain high levels of customer participation in a residential conservation program. 5 refs., 1 fig., 1 tab.

2920 Supply, Demand, And Forecasting

REFER ALSO TO CITATION(S) 20980, 21000, 21691

21727 **(DOE/ER/51063—T1) Balancing the national interest: US national security export controls and global economic competition.** (National Academy of Sciences, Washington, DC (USA)). 1987. Contract FG01-84ER51063. 262p. NTIS, PC A12/MF A01; 1; GPO Dep. Order Number DE88005355/JAW.

As part of its efforts to understand the full complexity of the issues associated with the national security export control problem - and in part to illuminate questions raised during the course of its deliberations - the Panel on the Impact of National Security Controls on International Technology Transfer commissioned a series of background working papers, some of which were prepared by outside consultants and others by the panel's professional staff. In all, the panel reviewed a total of 13 such papers on a wide variety of topics. Because of space limitations and because some of the papers were prepared for the panel on a confidential or classified basis, it was not possible to publish all of the studies. Nevertheless, we present here 7 of the unclassified papers, each representing a significant contribution to the public literature pertaining to international technology transfer and national security export controls. Individual papers are processed separately for the databases.

21728 **(EC/AD—R-36/Add.2) Overall economic perspective to the year 2000: Energy prospects in the ECE region; Projected gross energy consumption and net trade by fuel: 1985 and 2000 (MTOE).** (United Nations, Geneva (Switzerland). Economic Commission for Europe). 3 Dec 1987. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88900383/JAW.

The purpose of the study was to explore demand and supply prospects in the regions of the Economic Commission for Europe (ECE) to the year 2000. For North America and the European market economies a baseline and a higher oil price scenario are elaborated assuming within both scenarios a minimum and a maximum value of total energy demand evolution. For the centrally-planned economies total energy demand estimates are given for the baseline and higher oil price scenario, but also a variant with increased energy saving is examined for the baseline scenario. In this report, the analysis is extended to a projection of gross consumption by fuel. For this purpose, the minimum gross consumption outcome was used for North America and the European market economies and, correspondingly, the increased energy savings outcome for the East European countries and the USSR.

21729 (EUR—11038, pp 16-40) **Energy outlook for the European Community in a world context.** Leydon, K.; McGlue, D. 1987. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88920165/JAW. (CONF-8703233—).

From EC/OAPEC/OPEC seminar; Luxembourg, Luxembourg (17 Mar 1987).

The medium- and longer-term energy outlook for the European Community will be determined partly by factors within Europe. But the Community is and will remain the world's single largest importer of energy and oil. Developments on world energy markets are therefore bound to play a critical role in its energy future. Within the Community the crucial issues are the future prospects for energy efficiency; rates of investment in substitution for oil in the residential and industrial sectors; the outlook for the transport sector, which will determine more than anything else the Community's total oil requirements; choices for the 1990's about the structure of electricity-generating capacity; and levels of exploration and development of indigenous hydrocarbons. Overshadowing all these elements are major question marks about world economic growth and the evolution of the price of oil and other fuels on world markets linked to the outlook for oil supply and demand in the industrialized and the developing countries. This paper discusses the consequent uncertainties facing decision makers within the Community, identifying - on the basis of recent analytical work by the Commission services - a range of plausible outcomes for the main energy variables. 7 references, 3 figures, 12 tables.

21730 **(NEDO-P—8522) Enquete and hearing survey on energy consumption in commercial sector.** (New Energy Development Organization, Tokyo (Japan)). Mar 1986. 258p. (In Japanese). NTIS (US Sales Only), PC A12. Order Number DE88770058/JAW.

Data on energy for business use has remained particularly insufficient in the commercial sector. Thus a literature survey and a questionnaire survey were carried out to investigate the present situation of energy consumption. The estimation of consumption was performed based on three sets of data: (1) report of Research on Local Energy Development and Consumption (1980-1981), (2) floor space and specific energy consumption surveyed on various business fields and (3) Energy Balance Table (Energy Data and Modeling Center). The energy consumption in the commercial sector in fiscal 1980 is estimated at 23.2×10^{13} kcal from Data-1, 24.5×10^{13} kcal from Data-2 and 26.3×10^{13} kcal from Data-3. Results of the questionnaire survey have shown that the average specific energy consumption is 218 Mcal/m^2.year in office buildings, 280 Mcal/m^2.year in wholesale and retail stores, and 612 Mcal/m^2.year in restaurants. (136 figs, 160 tabs)

21731 **(SAND—87-3144) Emergency Management Information System (EMINS): System description and prototype software source code.** Desonier, L.M. (Sandia National Labs., Albuquerque, NM (USA)). Jan 1988. Contract AC04-76DP00789. 421p. NTIS, PC A18/MF A01; 1; GPO Dep. Order Number DE88006228/JAW.

Computer-based workstations are being developed for crisis management use in Department of Energy Operations Centers. This report describes the equipment and software used by EMINS and provides the source code for the software. A scenario has also been written and demonstrated; the scenario is included so EMINS can be demonstrated.

2930 Policy, Legislation, And Regulation

REFER ALSO TO CITATION(S) 20974, 21059, 21087, 21089, 21260, 21262, 21263, 21700, 21703, 21729

21732 (EUR—11038, pp 64-78) **Session II - energy-policy responses, strategies, and planning in the EC.** Jones, C. 1987. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88920165/JAW. (CONF-8703233—).

From EC/OAPEC/OPEC seminar; Luxembourg, Luxembourg (17 Mar 1987).

A key element of EC energy policy is the long-term energy objectives. This paper outlines the changes that have occurred in the EC's energy supply and demand as a result of the pursuit and attainment of these objectives. In 1986, new energy objectives, with the time horizon of 1995 were adopted. The factors that were taken into account in framing these objectives are described as well as the major sectoral energy-policy issues that must be taken into account if these objectives are to be attained. The role played by various Community actions in the field of energy policy, in contributing to the long-term energy policy objectives, is discussed. Since energy is a global concern, the international aspects of Community policy are considered. This embraces the Community's relations with industrialized, developing, and energy-producing countries. 2 figures, 4 tables.

2940 Fossil Fuels

REFER ALSO TO CITATION(S) 20750, 20885, 20886, 20887, 20930, 20968, 20972, 20972, 20973, 20974, 20975, 20976, 20977, 20978, 20979, 20980, 20981, 20981, 20982, 20996, 20998, 20999, 21000, 21000, 21000, 21025

2950 Hydrogen And Synthetic Fuels

REFER ALSO TO CITATION(S) 21209

2960 Electric Power

REFER ALSO TO CITATION(S) 20831, 21000, 21528, 21529, 21530, 21531, 21532, 21921, 22832

21733 (DOE/IE—0011) **Staff report: Electric power supply and demand for the contiguous United States, 1987-1996.** (USDOE Assistant Secretary for International Affairs and Energy Emergencies, Washington, DC. Office of Energy Emergency Operations). Feb 1988. 166p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE88006250/JAW.

This report reviews the bulk electric power supply and demand situation for the contiguous United States as projected for 1987-1996 in the April 1, 1987, IE-411 reports of the nine Regional Electric Reliability Councils. These annual reports are regarded as embodying the consensus of US electric utilities regarding the parameters of US electric power supply and demand for the next decade. The systems providing data for this report are listed in Appendix 3. Maps in Appendix 1 show the boundaries of the Councils and their subdivisions (the 26 Electric Regions). Discussions are provided concerning only those Councils and Electric Regions in which projected power supply reliability is in question; tabulations and data are included for all Regions and Councils. In addition, major topics related to the planning and operation of power systems are discussed briefly. 23 refs., 5 figs., 26 tabs.

21734 (DOE/PE—0079) **Northern lights: The economic and practical potential of imported power from Canada.** (USDOE Office of Policy, Planning and Analysis, Washington, DC). Dec 1987. 265p. NTIS, PC A12/MF A01; 1; GPO Dep. Order Number DE88006026/JAW.

This document contains ten appendices with extensive tables and charts on the electric power potential of Canada and that portion now supplied to the United States. The executive summary is written for the non-specialist and provides an evaluation of the data contained in the appendicies. (TEM)

21735 (EPRI-EM—5452) **Proceedings: Third national conference on utility demand-side management programs: DSM strategies in transition.** Limaye, S. (Synergic Resources Corp., Bala-Cynwyd, PA (USA)). Oct 1987. 446p. (CONF-870642—). Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920085/JAW.

From 3. national conference on utility demand-side management programs: DSM strategies in transition; Houston, TX, USA (16 Jun 1987).

In the 1980s, many utilities face competition, uncertain future demand and fuel costs, high capital and construction costs, and significant regulatory constraints. These 76 pepers illustrate how utilities are meeting these challenges through demand-side planning and management.

21736 (EPRI-EM—5452, pp 1.1-1.3, Section 1) **DSM [demand-side management] conference welcoming remarks.** Maddox, A. (Houston Lighting and Power Co., TX (USA)). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920085/JAW. (CONF-870642—).

From 3. national conference on utility demand-side management programs: DSM strategies in transition; Houston, TX, USA (16 Jun 1987).

This paper presents some of the motivations for the increased use of demand side management (DSM) in the electric power industry. Due primarily to the rise in fuel prices, the cost of generating electricity has also gone up. In order for electric industry to remain in business, some way of balancing customer load profiles must be used to improve utility system economics. The speaker lists the advantages of DSM as: (1) provides the customer with more control over energy bills; (2) improves efficiency of end-use applications; (3) provides options that give customers more choices; (4) and contributes to cost control. (JDH)

21737 (EPRI-EM—5452, pp 2.1-2.7, Section 2) **Refocusing your market management strategy.** Sawhill, J. (McKinsey and Co., Inc., Washington, DC (USA)). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920085/JAW. (CONF-870642—).

From 3. national conference on utility demand-side management programs: DSM strategies in transition; Houston, TX, USA (16 Jun 1987).

The economic and regulatory forces that have created an increasingly competitive environment in the electric power industry show no signs of abating. As a result, utilities must give careful consideration to what it takes to meet the needs of their customers and their shareholders. Demand-side managers have a critical role in this process. Much, if not all, of your job, is to help your companies respond to the competitive environment in which they operate. And the author believes that in general, many companies need to rethink at least some of what they have been doing to better target their demand-side or market efforts. How to create and implement such a focused market management strategy is what he'd like to discuss with you today.

21738 (EPRI-EM—5452, pp 3.1-3.5, Section 3) **Demand-side management strategies in transition.** Wiel, S. (Nevada Public Service Commission, Carson City (USA)). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920085/JAW. (CONF-870642—).

From 3. national conference on utility demand-side management programs: DSM strategies in transition; Houston, TX, USA (16 Jun 1987).

This paper describes reaction to increasing energy costs in the United States. Historical trends of electric energy in the United States are mentioned. From its beginning, electric power prices decreased until the mid 1970's. With the energy crisis came increasing electricity prices. Because of this, electric utilities and consumers are searching for ways to reduce their energy costs. (JDH)

21739 (EPRI-EM—5452, pp 4.1-4.10, Section 4) **The process of program planning and design at Boston Edison Company.** Kelly, K.A. (Boston Edison Co., MA (USA)). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920085/JAW. (CONF-870642—).

From 3. national conference on utility demand-side management programs: DSM strategies in transition; Houston, TX, USA (16 Jun 1987).

In the early '80s Boston Edison Company developed a collection of Conservation and Load Management (C and LM) programs as part of its IMPACT 2000 Plan. These programs were targeted at reducing usage of energy of all types and were directed primarily at the residential sector. In 1984 the Department of Public Utilities ordered the phasing out of all programs that reduced gas and oil consumption. Future programs would have to be cost-beneficial and aimed at reducing electric energy consumption. The Company reorganized the planning functions into one department in October 1984. Each of these functions was performed in separate departments prior to that time. The forecasting and supply planning areas were well established; however, demand planning required extensive development. This paper addresses the movement of this area from newly organized to where we are today.

21740 (EPRI-EM—5452, pp 5.1-5.7, Section 5) **Team approach to rate design benefits both utility and customer.** Picagli, A.J. (United Illuminating Co., Shelton, CT (USA)). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920085/JAW. (CONF-870642—).

From 3. national conference on utility demand-side management programs: DSM strategies in transition; Houston, TX, USA (16 Jun 1987).

The concept of "getting close to the customer," which has been recognized by utilities as a vital component of their day-to-day operations, has rarely been extended to include one of the most essential elements of the business: the development and design of rates. This process, as a rule, is characterized by the utility's initiative in determining the economic viability of a proposed new rate - from the utility's viewpoint - and in estimating the benefits to the customer - based on the utility's assumptions of the customer's needs. The direct involvement of the customer in the rate-making process occurs only at the point of regulatory hearings, which tends to impart an adversarial aspect to the relationship between the customer and the utility. The approach to rate design described in the following pages demonstrates that bringing a more customer-driven orientation to the rate-making process can effect results which are mutually beneficial to both the utility and the customer. By approaching the rate-making process as a team, with the customer directly involved from the beginning, both parties succeeded in achieving their goals.

21741 (EPRI-EM—5452, pp 6.1-6.8, Section 6) **Integrating demand-side programs into electric utility planning.** Flaim, T.A. (Niagara Mohawk Power Corp., Syracuse, NY (USA)). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920085/JAW. (CONF-870642—).

From 3. national conference on utility demand-side management programs: DSM strategies in transition; Houston, TX, USA (16 Jun 1987).

Like many other utilities nationwide, the Niagara Mohawk Power Corporation (Niagara Mohawk) is showing increasing interest in integrated least-cost planning - defined here as the planning process needed to determine the mix of demand- and supply-side options that would deliver a given energy service at the lowest cost. (The evaluation of cost should also incorporate risk and uncertainty but a discussion of these issues is beyond the scope of this paper.) We have developed a research and assessment strategy in our approach to demand-side planning for two reasons. First, we believe that a substantial amount of research and assessment is required before demand-side programs can be accepted with the same level of confidence as traditional supply technologies. Second, we expect to have ample capacity through the end of the century, and thus, have the time to conduct the multi-year experiments needed to resolve key uncertainties. The paper describes the analytical design of demand-side planning activities at Niagara Mohawk. It begins with a conceptual overview of integrated planning, and then describes the research we have underway to assess demand-side programs.

21742 (EPRI-EM—5452, pp 7.1-7.9, Section 7) **Marketing, financing and service delivery: Win/win strategies for utility/community partnerships.** Smith, A.E. (Community Energy Development Corp., Philadelphia, PA (USA)). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920085/JAW. (CONF-870642—).

From 3. national conference on utility demand-side management programs: DSM strategies in transition; Houston, TX, USA (16 Jun 1987).

A well designed utility/community partnership program can serve as an effective vehicle for marketing, financing, and delivering energy conservation improvements to the multifamily housing sector. The traditional barriers to energy conservation in this sector can be overcome through a marketing approach which identifies and responds to the needs of the many different players involved. A "portfolio" approach to the design of a program will help to ensure that the program is responsive to local needs and capabilities, while also offering generic technical and quality control standards. (JDH)

21743 (EPRI-EM—5452, pp 8.1-8.13, Section 8) **The welcome triangle: Utility, government, and community partnerships.** Morgan, S.J. (Technical Development Corp., Boston, MA (USA)). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920085/JAW. (CONF-870642—).

From 3. national conference on utility demand-side management programs: DSM strategies in transition; Houston, TX, USA (16 Jun 1987).

This paper discusses the reasons for recently increased cooperation between government and the public with electric utilities. (JDH)

21744 (EPRI-EM—5452, pp 9.1-9.10, Section 9) **Multifamily conservation potential through regulation of conversions.** First, C.R. (Seattle City Light, WA (USA)). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920085/JAW. (CONF-870642—).

From 3. national conference on utility demand-side management programs: DSM strategies in transition; Houston, TX, USA (16 Jun 1987).

This paper concerns the use of regulations to enforce the use of conservation measures in multifamily dwellings. The effect of legislation was investigated and several desirable characteristics for effective legislation were found. The paper lists the characteristics as (1) simplicity; (2) flexibility; (3) comparability; (4) low administrative costs; (5) generation of cost effective energy savings; and (6) application to various end uses. (JDH)

21745 (EPRI-EM—5452, pp 10.1-10.11, Section 10) **The effective interpretation of load research data for design and implementation of DSM [demand-side management] programs.** Purcell, L.P. (Electricity Supply Board, Dublin (Ireland)). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920085/JAW. (CONF-870642—).

From 3. national conference on utility demand-side management programs: DSM strategies in transition; Houston, TX, USA (16 Jun 1987).

Traditionally, utilities have used load research for rate design, with a prime objective being equitable allocation of costs among customer categories. Now load research is being used more and more to reduce those costs by contributing to demand-side load management (DSM). At the central level, data from load research is used to identify DSM potential and to develop strategies to exploit this potential. Success of DSM is heavily dependent on customer acceptance. For this reason it is essential to have full involvement of personnel who are in front-line contact with customers, particularly when dealing with non-residential loads. Load research data has a major role to play at the local level but it must be

presented in a form in which it can be readily used by the nonspecialist. The Electricity Supply Board (ESB) has been involved with load research and DSM both as a utility and in a consultancy capacity. This paper examines some of the issues which have been encountered and some of the techniques which have been found to be effective. 6 figs.

21746 (EPRI-EM—5452, pp 11.1-11.10, Section 11) **The benefits of using end-use load shape data for effective demand-side management.** Hauser, S.G.; Scheer, R.M.; Warwick, M. (Pacific Northwest Lab., Portland, OR (USA); Energetics Inc., Columbia, MD (USA); Bonneville Power Administration, Portland, OR (USA)). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920085/JAW. (CONF-870642—). Contract AC06-76RL01830.

From 3. national conference on utility demand-side management programs: DSM strategies in transition; Houston, TX, USA (16 Jun 1987).

Demand-side management (DSM) can be defined as the process of understanding the consumer sufficiently to produce changes in utility load shape in ways that benefit both the consumer and the utility. This paper discusses some of the benefits of collecting end-use data and presents several examples of how the data can be applied to DSM based on our experience with a large-scale metering project conducted for the Bonneville Power Administration (BPA) by the Pacific Northwest Laboratory. For this project (the End-use Load and Conservation Assessment Program, or ELCAP), approximately 430 residences and 140 commercial buildings have been instrumented with field data acquisition technology that captures up to eight different end-uses in each residence and up to 22 end-uses for each commercial building. We also measure meteorological data and internal temperatures for many sites. Most of the sites have at least one year's worth of data with a 90% or better data capture rate. 5 refs., 5 figs.

21747 (EPRI-EM—5452, pp 12.1-12.10, Section 12) **End-use data requirements for demand-side planning.** Caldwell, R.W. (Sierra Pacific Power Co., Reno, NV (USA)). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920085/JAW. (CONF-870642—).

From 3. national conference on utility demand-side management programs: DSM strategies in transition; Houston, TX, USA (16 Jun 1987).

Sierra believes that load profile data at the end-use level are critical to demand-side planning. Information on end-use profiles is needed to comply with mandated methods of end-use forecasting and demand-side planning. Regulation requires this data to be "substantially accurate." Some measure of accuracy for each hour on selected day-types is required in order to eventually calculate the impact of "inaccuracy" on the results of forecasting and demand-side planning. Much of the information needed for end use forecasting and demand-side planning is the same. End-use forecasting develops baseline conditions which demand-side planning seeks to modify. Methods, software and hardware, are available to implement the data-gathering system to obtain the needed end-use profiles. 4 figs.

21748 (EPRI-EM—5452, pp 13.1-13.9, Section 13) **Demand-side management: Providing a competitive edge.** Schneider, C. (House of Representatives, Washington, DC (USA)). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920085/JAW. (CONF-870642—).

From 3. national conference on utility demand-side management programs: DSM strategies in transition; Houston, TX, USA (16 Jun 1987).

This paper describes the social benefits of demand-side management. The topics covered in this report are economic benefits due to energy savings, improved environmental quality, enhancement to the national security, and increased competitiveness of American products in world markets. (JDH)

21749 (EPRI-EM—5452, pp 14.1-14.6, Section 14) **Modifying traditional demand-side management to respond to changing corporate objectives.** Caskey, J.F. (Pacific Gas and Electric Co., San Francisco, CA (USA)). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920085/JAW. (CONF-870642—).

From 3. national conference on utility demand-side management programs: DSM strategies in transition; Houston, TX, USA (16 Jun 1987).

This paper describes how Pacific Gas and Electric (PG and E) has modified its menu of demand-side management (DSM) projects to respond to changing corporate and load shape objectives. The author goes further to investigate changes that have occurred in various DSM projects that are not directly attributed to the modified objectives. By investigating these somewhat subtle changes, the author has discovered several trends that may provide a key to future DSM programs.

21750 (EPRI-EM—5452, pp 15.1, Section 15) **Least cost planning: A community-wide perspective.** Gautier, D.; Clinton, J. Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920085/JAW. (CONF-870642—).

From 3. national conference on utility demand-side management programs: DSM strategies in transition; Houston, TX, USA (16 Jun 1987).

21751 (EPRI-EM—5452, pp 16.1-16.11, Section 16) **Residential demand-side screening model.** Levy, R.D.; Smith, W.M.; Anderson, K.D. (Levy Associates, Sacramento, CA (USA); Electric Power Research Institute, Palo Alto, CA (USA); American Public Power Association, Washington, DC (USA)). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920085/JAW. (CONF-870642—).

From 3. national conference on utility demand-side management programs: DSM strategies in transition; Houston, TX, USA (16 Jun 1987).

Demand-side management (DSM) programs are experiencing a renewed interest. More utilities are now looking for ways to improve the utilization of current resources and reduce future resource uncertainties, while simultaneously appeasing customer demands for improved or less costly service. With the increasing dependence on DSM programs comes the necessity to balance ever more complex load shaping and customer service objectives and to find some logical way to choose from among an almost endless variety of program and technology options. What once involved little more than experimenting with one or two programs has become a complex planning and evaluation process. This paper describes a method developed for residential demand-side management planning.

21752 (EPRI-EM—5452, pp 17.1-17.10, Section 17) **ElectriCREDIT: A direct load control learning experience.** Birnbaum, I.L. (City of Austin Electric Utility Dept., TX (USA)). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920085/JAW. (CONF-870642—).

From 3. national conference on utility demand-side management programs: DSM strategies in transition; Houston, TX, USA (16 Jun 1987).

ElectriCREDIT is the City of Austin Electric Utility's direct load control program. The ElectriCREDIT pilot program was initiated in June 1986 in the Slaughter substation service area in south Austin. Residential and non-demand commercial customers in the Slaughter area are eligible for the pilot program. Participants receive specified bill discounts in proportion to the level of cycling which they select for some of their major electrical equipment. Cycling is accomplished through FM radio signals sent to receiver/switches installed on the participants' equipment. Electrical equipment which may be cycled under the ElectriCREDIT program includes central electric cooling systems (air conditioners and heat pumps), central electric resistance heating, electric water heaters, and swimming pool pumps. This paper describes the program, its implementation, and summarizes the results. 1 tab.

21753 (EPRI-EM—5452, pp 18.1-18.11) **Lessons learned from a research and demonstration commercial retrofit project.** Cleary, C.M. (Seattle City Light, WA (USA)). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920085/JAW. (CONF-870642—).

From 3. national conference on utility demand-side management programs: DSM strategies in transition; Houston, TX, USA (16 Jun 1987).

Seattle City Light (SCL) is currently conducting a research and demonstration Commercial Retrofit Study with a small sample of buildings representing the utility's commercial customer load. The eight buildings include two office buildings, two retail stores, two grocery stores, and two restaurants. The study involves collecting hourly measurements of electricity consumption by end-use and identifying potential conservation improvements with computer simulation models. With financial support from the Bonneville Power Administration (BPA), an optimum combination of selected improvements was installed in each building. The optimum set of measures consisted of those measures with the best total benefit/cost ratio to the utility based on the utility's value of the energy savings. The benefit of implementing the conservation measure installations to the utility is twofold. First, this study provided valuable experience to utility staff in the administration of conservation retrofits in commercial buildings. The lessons learned from this small demonstration project were applied to future utility commercial programs. Second, after a sufficient amount of postretrofit data has been collected, this research study will provide data on the true load reductions due to the conservation measures. It also will provide an opportunity to compare the predicted, simulated loads by end-use with actual loads. This information will be used to support commercial sector conservation potential assessment and strategic planning efforts in the utility. This paper presents the steps taken, problems encountered, and lessons learned in the process of retrofitting the study buildings with these measures. 2 refs., 2 figs., 2 tabs.

21754 (EPRI-EM—5452, pp 19.1-19.7, Section 19) **The Palo Alto experience: Rebates as an incentive for commercial/industrial customers.** Dimit, M.G. (City of Palo Alto Utilities Dept., CA (USA)). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920085/JAW. (CONF-870642—).

From 3. national conference on utility demand-side management programs: DSM strategies in transition; Houston, TX, USA (16 Jun 1987).

In January 1985, the City of Palo Alto's Utilities Department implemented a five-year electric peak reduction program called PARTNERS to provide incentives (rebates) to commercial/industrial customers that install electrical demand-reducing equipment. About 2.7 MW of demand-reducing projects have been installed ranging from window film to HVAC improvements. Over $450,000 in rebates have been awarded. PARTNERS is one of several load management strategies that the Energy Services section of the Utilities Department has adopted. These strategies are targeted at the largest 750 customers and most intensely at the 300 largest, which make up 80% of the utilities' summer peak electrical demand of 185 MW. Load management is very important to Palo Alto since the City has exceeded its 175 MW low-cost supply (mainly hydroelectric) and supplemental power is four times as expensive. Marketing efforts consist of direct mailings, workshops, newsletters, phone calls, and staff visits to the largest customers. Personal marketing and the development of working relationships with those customers and area vendors and consultants are emphasized.

21755 (EPRI-EM—5452, pp 20.1-20.14, Section 20) **End-use load data for DSM [demand-side management] analysis: Results from EPRI's DSM project.** Braithwait, S.D.; McDonald, C. (Electric Power Research Institute, Palo Alto, CA (USA)). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920085/JAW. (CONF-870642—).

From 3. national conference on utility demand-side management programs: DSM strategies in transition; Houston, TX, USA (16 Jun 1987).

One of the key challenges to the complete acceptance of demand-side management (DSM) alternatives is the development of accurate and defensible estimates of the load shape impacts (i.e., customer response) of DSM alternatives. A key element of the recent Electric Power Research Institute (EPRI) DSM project was the development of data bases and guidelines to provide electric utilities with an enhanced capability for analyzing customer response to DSM alternatives. The Customer Response data base includes typical end-use load shapes for many DSM alternatives for both the residential and commercial sectors. In addition, several user-friendly IBM-PC compatible software products were developed to help utilities estimate end-use load shapes and analyze customer response. 6 refs., 5 figs.

21756 (EPRI-EM—5452, pp 21.1-21.14, Section 21) **Customer acceptance: Designing DSM [demand-side management] programs that attract customers.** Davis, T.D. Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920085/JAW. (CONF-870642—).

From 3. national conference on utility demand-side management programs: DSM strategies in transition; Houston, TX, USA (16 Jun 1987).

This paper analyzes data collected on electric utility participation rates for demand-side management (DSM) programs. Program participation levels are described based on the use of various marketing techniques and levels of marketing intensity. The approach is consistent with a behavioral model that was used to guide the research. Case studies of utility programs that resulted in high participation levels are also provided. Finally, preliminary guidelines on designing DSM programs are provided. 7 refs., 3 tabs.

21757 (EPRI-EM—5452, pp 22.1-22.7, Section 22) **Demand-side management program implementation.** Smith, W.M.; Michaels, H.G. (Electric Power Research Institute, Palo Alto, CA (USA); XENERGY, Inc., Burlington, MA (USA)). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920085/JAW. (CONF-870642—).

From 3. national conference on utility demand-side management programs: DSM strategies in transition; Houston, TX, USA (16 Jun 1987).

A demand-side management program effectively extends the range of marketing and energy services offered by the utility. Program implementation is the process of taking a program from conception, making it operational and effective for the customer, and continuing to operate it in a manner responsive to the customer. This paper summarizes an EPRI project conducted by XENERGY to examine the experiences of electric utilities relating to program implementation. As a part of the demand-side management (DSM) framework, the implementation topic concentrates on the organizational issues, procedures, staffing, and delivery of DSM program services. The goal of the project is to uncover characteristics of program implementation that broadly correlate to program success, where success as meeting the program's objectives.

21758 (EPRI-EM—5452, pp 23.1-23.10, Section 23) **Developing an integrated resource plan and planning process at Puget Power.** Hirst, E.; Knutsen, C. (Oak Ridge National Lab., TN (USA)). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920085/JAW. (CONF-870642—).

From 3. national conference on utility demand-side management programs: DSM strategies in transition; Houston, TX, USA (16 Jun 1987).

This paper discusses the progress that Puget Sound Power and Light Company (Puget) has made in pursuing a new project, Demand and Resource Evaluation (DARE), which began in early 1986. The purposes of DARE are: (1) to strengthen the integrated planning process within Puget Power; and (2) to develop an integrated resource plan for Puget Power. 5 refs., 1 tab.

21759 (EPRI-EM—5452, pp 24.1-24.9, Section 24) **Integrated planning: Economic screening analysis methods used at Wisconsin Power and Light, April 1987.** Porter, D.; Endres, V.; McKellar, B.J.; Jablonka, G. (Wisconsin Power and Light, Madison (USA)). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920085/JAW. (CONF-870642—).

From 3. national conference on utility demand-side management programs: DSM strategies in transition; Houston, TX, USA (16 Jun 1987).

Wisconsin Power and Light (WPL), along with the other Wisconsin utilities, is involved in a rigorous analysis to determine the least-cost resource plan to meet future utility and customer needs. The analysis includes integration of utility supply and demand options with customer supply and demand options to achieve an overall integrated plan. The diversity and number of options in these four supply and demand categories presented a tremendous analytical challenge. The volume of data and information needed to analyze all of the options in a consistent and meaningful manner with currently available models would require more time and resources than were available to or obtainable by WPL. WPL developed a software tool called IPEP (short for Integrated Planning Evaluation Program) to analyze all supply and demand options in a consistent, straightforward manner, without requiring extensive data. The methods used were designed to provide a rigorous economic screening of the options. WP and L's approach allows analysts to test ideas for many options in quick manner. This paper describes the methods and approaches that Wisconsin Power and Light uses to accomplish this rigorous economic screening. 2 figs.

21760 (EPRI-EM—5452, pp 25.1-25.9, Section 25) **GPU strategic market planning.** Roddy, M.G.; Bloom, J.A. (Jersey Central Power and Light Co., Morristown, NJ (USA)). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920085/JAW. (CONF-870642—).

From 3. national conference on utility demand-side management programs: DSM strategies in transition; Houston, TX, USA (16 Jun 1987).

In today's business environment, utility managers must adapt to a changing future and strive to minimize cost to customers, maintain markets against competition, and earn satisfactory returns for the stockholders. Recognizing the need for flexible planning, General Public Utilities (GPU) is rethinking directions for demand-side programs. This paper describes GPU's approach to market strategy and demand management planning at Jersey Central Power and Light (JCP and L), an operating subsidiary of GPU.

21761 (EPRI-EM—5452, pp 26.1-26.10, Section 26) **Marketing utility demand-side management in a competitive environment.** Doll, L.R.; Howard, R.T. (City of Austin Electric Utility Dept., TX (USA)). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920085/JAW. (CONF-870642—).

From 3. national conference on utility demand-side management programs: DSM strategies in transition; Houston, TX, USA (16 Jun 1987).

Only a few years ago, the City of Austin established an aggressive program to pursue demand-side management programs that would result in a 553 MW reduction in peak load growth. Conservation and direct-load control are the cornerstones of the options to meet this goal. Today, the City faces significant competition from numerous sources to serve the load of its existing large industrial and government customers and to capture a significant share of the anticipated load growth in these sectors. The potential impact of lost loads and lost market share is tremendous. Thus while a reduction in peak load growth through energy efficiency gains is important, this must be balanced with the pressure to remain competitive in the current energy market. The purpose of this paper is to examine the role of demand-side management programs as a marketing strategy in a competitive market. We describe how the demand-side programs have been structured to meet the competitive threat and demonstrate the benefit of structuring a competitive strategy that retains existing loads. 3 figs., 3 tabs.

21762 (EPRI-EM—5452, pp 27.1-27.8, Section 27) **The Power Package: A marketing strategy for conservation and load management rebate programs.** Eder, E.S. (Boston Edison, MA (USA)). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920085/JAW. (CONF-870642—).

From 3. national conference on utility demand-side management programs: DSM strategies in transition; Houston, TX, USA (16 Jun 1987).

The Power Package was first made public by Boston Edison in October 1986. At the time it consisted of three conservation and load management (CLM) rebate programs available to commercial and industrial customers. It was expanded this spring to include six new programs, three of which are available to residential customers. More programs will be implemented in the future. This paper describes the programs and their implementation.

21763 (EPRI-EM—5452, pp 28.1-28.7, Section 28) **Western Massachusetts Electric Company performance contracting pilot.** Cameron, D.F. Jr. (Northeast Utilities, Rocky Hill, CT (USA)). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920085/JAW. (CONF-870642—).

From 3. national conference on utility demand-side management programs: DSM strategies in transition; Houston, TX, USA (16 Jun 1987).

In its effort to meet the region's energy needs into the next decade, Northeast Utilities (NU) recognizes the importance of weighing and comparing the relative merits of different supply and demand-limiting options. NU's Integrated Demand and Supply Planning (IDSP) was initiated in 1983 as a process for evaluating options for controlling increases in demand and providing additional sources of supply when needed. It is this development of a variety of planning "scenarios" with greater flexibility to meet changing circumstances that helps to underline NU's commitment to meeting its energy responsibilities. This paper describes IDSP and presents energy savings attributed to it.

21764 (EPRI-EM—5452, pp 30.1-30.10, Section 30) **Home energy rating systems: An analysis of a voluntary demand-side management program.** Vine, E.; Barnes, B.K.; Ritschard, R. (Lawrence Berkeley Lab., CA (USA)). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920085/JAW. (CONF-870642—). Contract AC03-76SF00098.

From 3. national conference on utility demand-side management programs: DSM strategies in transition; Houston, TX, USA (16 Jun 1987).

In the last few years, demand-side management has become one of the most important activities conducted by utility companies and local and state government agencies in their planning and evaluation of energy conservation programs. The principal objectives of demand-side programs are to reduce energy consumption and to change load shapes (as reflected in changes in the time pattern and magnitude of a utility's load) by actively influencing consumer demand for electricity through such programs as load management, strategic conservation, rate innovation, and marketing. The programs often rely on voluntary participation by consumers, and utilities and governments commonly offer a wide range of inducements to encourage participation. The effectiveness of these programs and inducements depends on an in-depth understanding of consumer needs and "perspectives," which need to be constantly reassessed during program implementation. As an example of how these needs are assessed and addressed in a voluntary demand-side management program, we present findings from our recent survey of home energy rating programs currently being conducted by utility companies, governmental agencies, and other organizations. 2 refs., 1 tab.

21765 (EPRI-EM—5452, pp 33.1-33.10, Section 33) **Evaluation, methodology, and results of Atlantic Electric's operational demand-side management program, 1983-1986.** Jansson, P.M.; Nguyen, T.K. (Atlantic Electric, Pleasantville, NJ (USA)). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920085/JAW. (CONF-870642—).

From 3. national conference on utility demand-side management programs: DSM strategies in transition; Houston, TX, USA (16 Jun 1987).

The following study was undertaken in September 1986 with the goal of quantifying the measurable/observable savings that customers have experienced by participating in Atlantic Electric's (AE's) demand-side management (DSM) programs to date. This is the first time such an analysis of this magnitude was directed at the operational programs. Due to the need to have customer energy usage patterns both before and after program participation for evaluation, this was also the first time since these programs were implemented that the data base was sufficient to undertake this analysis. The analysis was conducted on a program-by-program basis in order that such results could be useful in determining the disposition of individual programs in meeting the Company's strategic load reduction goals. 3 figs., 1 tab.

21766 (EPRI-EM—5452, pp 34.1-34.12, Section 34) **The DSM [demand-side management] technical audit: An integral step to least-cost planning.** Rothstein, E.P.; Camera, R.K. (City of Austin, TX (USA)). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920085/JAW. (CONF-870642—).

From 3. national conference on utility demand-side management programs: DSM strategies in transition; Houston, TX, USA (16 Jun 1987).

The purpose of this paper is to present an approach which addresses the uncertainties associated with implementing demand-side management (DSM) options by clarifying the analysis of program impact. Extensive data and research requirements lead to evaluators employing various assumptions with varying degrees of confidence. However, the DSM Technical Audit is a useful framework for evaluation of existing information and the development of new information. Further, it can constitute a formal step toward integrated least-cost utility planning. 7 refs., 13 figs.

21767 (EPRI-EM—5452, pp 35.1-35.13, Section 35) **Lessons learned from EPRI's customer preference project: Planning DSM [demand-side management] marketing programs.** Lewis, L.E.; O'Rourke, P.D. (Electric Power Research Institute, Palo Alto, CA (USA); Booz-Allen and Hamilton, Inc., Bethesda, MD (USA)). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920085/JAW. (CONF-870642—).

From 3. national conference on utility demand-side management programs: DSM strategies in transition; Houston, TX, USA (16 Jun 1987).

This paper highlights some of our early experiences with the utilities that are participating as case studies for the EPRI Customer Preference and Behavior project. During the past six months, we have worked with these utilities to define DSM program concepts, conduct relevant market research, and begin planning the marketing implementation effort. As a group, these case study utilities have been enthusiastic supporters of the EPRI project, have recognized the need for undertaking research to improve their marketing skills base, and have positioned their best people against the issue of DSM marketing planning and implementation. The following points summarize the lessons learned from this early work, which we hope will assist other utilities in the planning stages of DSM program development: (1) existing background data on customers should be scanned early in the planning process to evaluate its applicability for supporting detailed microeconomic analyses of customer participation in DSM programs; (2) DSM programs should be broadly defined first, and detailed technology-related decisions should follow market research activities; (3) qualitative market research can provide quick and relatively inexpensive insights into customer interests in various DSM programs and technologies; and (4) quantitative market research can help develop ranges of the total potential market size for DSM programs. 3 figs.

21768 (EPRI-EM—5452, pp 36.1-36.11, Section 36) **Target customer and technology selection process for a commercial marketing program: The role of customer and trade ally research.** Brooks, B. (Gulf States Utilities Co., Beaumont, TX (USA)). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920085/JAW. (CONF-870642—).

From 3. national conference on utility demand-side management programs: DSM strategies in transition; Houston, TX, USA (16 Jun 1987).

When Gulf States Utilities (GSU) dropped marketing from its vocabulary in the early '70s and began emphasizing conservation, marketing activities were eliminated. However, no significant commercial conservation programs were initiated. The combination of slow load growth, new coal and nuclear generation, and the swelling of cogeneration spurred by PURPA left GSU with excess capacity. In order to maintain a satisfactory cash position, GSU sought rate relief for new plant, took actions to reduce expenses, and initiated a program to increase sales. The commercial marketing component of this sales effort is the topic addressed here. 7 figs.

21769 (EPRI-EM—5452, pp 37.1-37.6, Section 37) **Determinants of participation in conservation programs.** Robinson, M.D.; Rosenblum, J.I. (Public Utility Commission of Texas, Austin (USA)). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920085/JAW. (CONF-870642—).

From 3. national conference on utility demand-side management programs: DSM strategies in transition; Houston, TX, USA (16 Jun 1987).

Evaluation of utility conservation programs is an important activity, given the increased emphasis being placed on conservation as a means of meeting peak demand and the resources going to increase conservation activities. A large problem in measuring the impact of utility conservation programs is the difficulty in separating conservation due to price effects from conservation due to the actions taken by the utility. This paper analyzes the impact of utility information programs on customers of Texas-New Mexico Power. We attempt to distinguish between price effects and conservation information effects for five conservation activities identified in Texas-New Mexico Power Company's (TNP) 1985 Residential Customer Survey. After a brief discussion of the economics of the choice to implement conservation activities, results of a logit probability model of appliance choice are presented. 1 ref., 4 tabs.

21770 (EPRI-EM—5452, pp 39.1-39.16, Section 39) **Cost recovery in least-cost utility planning: The forgotten factor.** Wellinghoff, J.B. Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920085/JAW. (CONF-870642—).

From 3. national conference on utility demand-side management programs: DSM strategies in transition; Houston, TX, USA (16 Jun 1987).

Least-cost utility planning (LCUP) is having a significant impact on the way the electric utility industry looks at meeting the future energy needs of this nation. At least nine state public service commissions have adopted an LCUP process, either under the authority of a statute, their own regulations, or from case decisions. An additional six states have major portions of a least-cost planning procedure in place and seven other jurisdictions are actively considering LCUP. Both the National Association of Regulatory Utility Commissioners (NARUC) and the National Association of State Utility Consumer Advocates (NASUCA) have passed resolutions endorsing the LCUP concept. The Federal Department of Energy (DOE) has an ongoing LCUP project, and LCUP is currently a "hot topic" on the utility conference circuit. This paper examines LCUP from a public policy perspective. 34 refs.

21771 (EPRI-EM—5452, pp 40.1-40.10, Section 40) **Designing and evaluating joint action approaches to demand-side management programs for small utilities.** Bachman, A.L.; Hoffman, M.G. (Massachusetts Executive Office of Energy Resources, Boston (USA)). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920085/JAW. (CONF-870642—).

From 3. national conference on utility demand-side management programs: DSM strategies in transition; Houston, TX, USA (16 Jun 1987).

The Massachusetts Executive Office of Energy Resources (the Energy Office) has been encouraging the consideration of demand-side programs by municipal electric utilities in Massachusetts. Thirty-four of the municipal utilities are members of a joint action agency, the Massachusetts Municipal Wholesale Electric

Company (MMWEC), which provides its members with power supply planning, power and capacity purchasing, and load forecasting services. The rationale for providing these services is that the member utilities are frequently small and without staff to do forecasting and planning or to independently participate in power supply projects. Bulk purchases of capacity and power provide substantial economies of scale which are captured through joint action. These benefits should be available on the demand side. Small utilities usually do not have the staff to design and implement a broad array of conservation and load management programs, nor do they have the resources to do the load and market research necessary for successful, targeted programs. Furthermore, there should be significant economies of scale in program administration as well as in purchasing and installing conservation and load management technologies. This paper presents the results of our work on the feasibility of joint action by MMWEC on DSM. First, we describe the existing joint action efforts on the demand side. We then present a case study that includes the design and benefit-cost evaluation of seven conservation programs appropriate for joint action on the part of small utilities. The purpose is to examine the program design issues, develop an administrative plan for joint action among voluntary member utilities, and determine the benefit-cost ratio from utility and participants' perspectives. 9 refs., 2 tabs.

21772 (EPRI-EM—5452, pp 41.1-41.8, Section 41) **Impacts of Texas-New Mexico Power's conservation information programs.** Robinson, M.D.; Bachmeier, R.; Rosenblum, J.I. (Public Utility Commission of Texas, Austin (USA)). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920085/JAW. (CONF-870642—).

From 3. national conference on utility demand-side management programs: DSM strategies in transition; Houston, TX, USA (16 Jun 1987).

This paper develops a methodology for testing the impact of conservation information programs and evaluates the conservation information programs of Texas-New Mexico Power Company. Often it is argued that information programs provide little return in direct conservation, but may have larger returns in secondary benefits (such as enticing participants to rebate programs). Given the rather large saturation of information programs and the general acceptance that information programs provide little actual conservation, this paper reports the results of a study designed to determine whether information programs have any direct impact on electricity consumption. A model of conservation information as technology is developed that predicts that increased information to customers will result in changes in electricity consumption and in price elasticity of demand. Using this framework, conditional demand estimates are completed that indicate that information programs do reduce consumption modestly and increase price elasticities. 3 refs., 3 tabs.

21773 (EPRI-EM—5452, pp 42.1-42-11, Section 42) **Evaluating a Model Conservation Standards program.** Bronfman, B.H.; Horowitz, M.J.; Lerman, D.I. (International Energy Associates Ltd., Portland, OR (USA)). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920085/JAW. (CONF-870642—).

From 3. national conference on utility demand-side management programs: DSM strategies in transition; Houston, TX, USA (16 Jun 1987).

This paper describes a comprehensive evaluation of the Model Conservation Standards (MCS) program as implemented in Tacoma, Washington. By comprehensive evaluation we mean a detailed examination of a program containing, at a minimum, both process evaluation and outcomes evaluation components. A process evaluation deals with program implementation, analyzing the way in which a program or project was actually applied to a given situation. This effort typically includes discussions and interviews with managers, consumers, and sponsors, the collection of summary data such as rates of implementation and costs, and frequently includes recommendations for improving program delivery. An outcomes evaluation is an assessment of the success with which a given program or project met its stated goals. For energy projects, these goals are typically expressed as energy or demand savings. However, outcomes evaluations may also include other, secondary goals such as program penetration rates and cost-effectiveness. 7 refs., 2 tabs.

21774 (EPRI-EM—5452, pp 43.1-43.10, Section 43) **Energy efficient new homes programs: Utility experiences.** Callaway, J.W.; Branch, K.R. (Pacific Northwest Labs., Portland, OR (USA); Battelle Seattle Research Center, WA (USA)). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920085/JAW. (CONF-870642—).

From 3. national conference on utility demand-side management programs: DSM strategies in transition; Houston, TX, USA (16 Jun 1987).

In 1986, the Bonneville Power Administration and many Pacific Northwest utilities embarked on an unparalleled effort to encourage the construction of new homes in the BPA region that go beyond current levels of space heating energy efficiency. By 1995, regional power plans call for 85% of new, electrically space heated homes to be built to these levels, termed the Model Conservation Standards (MCS) by their proposer, the Northwest Power Planning Council. To assist in the development of utility-sponsored new homes programs in the Northwest, a survey was conducted of utilities that have had practical experience in efforts to increase the efficiency of new homes built in their service areas. This paper discusses the results of that survey. 8 refs., 1 tab.

21775 (EPRI-EM—5452, pp 44.1-44.11, Section 44) **Assessing market penetration of new end-use technologies.** Limaye, D.R.; McDonald, C. Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920085/JAW. (CONF-870642—).

From 3. national conference on utility demand-side management programs: DSM strategies in transition; Houston, TX, USA (16 Jun 1987).

A key question faced by the utility demand-side management (DSM) planner or marketing manager is the prediction of the market acceptance of the technology being promoted. The problems are particularly challenging in the commercial and industrial sectors because of the diversity of customer types and the complexity of the decision processes. This paper describes the structure and application of a model to assess the market penetration of new end-use technologies in the commercial sector. 7 figs., 2 tabs.

21776 (EPRI-EM—5452, pp 45.1-45.10, Section 45) **Customer acceptance and potential market penetration of DSM [demand-side management] programs at Central Maine Power Company.** Spellman, R.F.; Ballou, K.C.; Ecker, L.S. (Central Maine Power Co., Augusta (USA)). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920085/JAW. (CONF-870642—).

From 3. national conference on utility demand-side management programs: DSM strategies in transition; Houston, TX, USA (16 Jun 1987).

Marketing of conservation and load management programs to customers is a relatively new phenomenon for the electric utility industry. At Central Maine Power Company (CMP), delivery of demand-side programs to customers and development of marketing strategies have only been in existence since the early 1980s. Secondly, it is only recently that market research techniques have expanded beyond estimating appliance saturations and energy usage characteristics. Concepts such as test marketing of demand-side products and use of such techniques as focus group research and positioning studies are relatively new, at least in New England. Thirdly, it appears that universal customer acceptance of demand-side programs which reduce utility loads has yet to be achieved. This paper will discuss the basis for CMP's marketing strategy for demand-side programs, and will highlight some basic principles for enhancing participation in energy management programs based on recent experience with market tests in the CMP service area. 1 tab.

21777 (EPRI-EM—5452, pp 46.1-46.14, Section 46) **Explicit use of market penetration in DSM [demand-side management] planning.** Norland, D.L. Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920085/JAW. (CONF-870642—).

From 3. national conference on utility demand-side management programs: DSM strategies in transition; Houston, TX, USA (16 Jun 1987).

The Alliance to Save Energy has developed a methodology for explicitly using market penetration in DSM planning. This method, developed in two case studies with Arkansas Power and Light Company and General Public Utilities Corporation, meets today's needs for DSM program screening tools that are understandable and useful to top level utility management and public service commissioners. This paper describes the market penetration part of our approach to DSM planning, both conceptually and by reference to actual analyses performed in the GPU case study. We feel that the explicit treatment of market penetration of all electricity-using or saving options is required to meet today's DSM planning and forecasting needs. 7 refs., 3 tabs.

21778 (EPRI-EM—5452, pp 47.1-47.8, Section 47) **Stakeholder involvement in least cost planning research.** Millar, C.W. (Michigan Dept. of Commerce, Lansing (USA)). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920085/JAW. (CONF-870642—).

From 3. national conference on utility demand-side management programs: DSM strategies in transition; Houston, TX, USA (16 Jun 1987).

This paper describes the organization of a Michigan utility study group formed to investigate electricity use and plan for the utility's growth. (JDH)

21779 (EPRI-EM—5452, pp 48.1-48.10, Section 48) **Strengthening least-cost utility planning: How the US Department of Energy plans to help.** Scheer, R.M.; Millhone, J.P. (Energetics Inc., Columbia, MD (USA); Dept. of Energy, Washington, DC (USA)). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920085/JAW. (CONF-870642—).

From 3. national conference on utility demand-side management programs: DSM strategies in transition; Houston, TX, USA (16 Jun 1987).

The nation's electric and gas utilities face several critical challenges in the years ahead, challenges such as uncertain but flatter demand growth; high levels of financial risk associated with new power plant construction; increased competition from alternative fuels, other utilities and self-generation; regulatory changes, including likely acid rain legislation and deregulation initiatives; and anticipated capacity constraints in the mid 1990s. The need for the utility industry to adapt to market forces if it hopes to survive and prosper is clear. The US Congress has recognized these challenges and funded a least-cost utility planning initiative intended to ensure that the public receives reliable, low-cost energy services. Least-cost utility planning represents an approach to utility resource planning in which both supply- and demand-side data options are assessed for their potential contribution toward providing adequate and reliable energy services for the lowest cost. As a part of the initiative, the US Department of Energy (DOE) received an appropriation to promote least-cost planning within the nation's electric and gas utilities. The provisions of the legislation called for DOE to develop a plan that describes the research, technology transfer, and other activities that DOE will undertake to promote and strengthen least-cost planning practices nationwide. This paper presents the major elements of that research plan as well as some thoughts from utility planning experts consulted extensively during development of the plan. 1 fig., 1 tab.

21780 (EPRI-EM—5452, pp 49.1-49.9, Section 49) **Evaluation's role in least-cost planning and demand-side management: Contending state and national policy perspectives.** Sissine, F. Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920085/JAW. (CONF-870642—).

From 3. national conference on utility demand-side management programs: DSM strategies in transition; Houston, TX, USA (16 Jun 1987).

This paper notes the increased attention that has been given alternative electrical resource options in planning for future power needs. It reviews the three primary evaluation methods used to project the ability of these options to displace conventional power plant construction. By examining basic criteria, all of these methods were shown to have shortcomings which prevent them from producing ideally integrated least-cost plans. Some applications of these methods fail to follow least-cost principles, while others are hampered by technical barriers which might be overcome with further research. The report also suggests that process and ex post evaluation methods, which focus on actual program impacts, could also help improve the least-cost planning process. 10 refs.

21781 (EPRI-EM—5452, pp 50.1-50.10, Section 50) **Analysis of the load and energy impacts of a direct load control program.** Becker, M.A. (City of Austin Electric Utility, TX (USA)). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920085/JAW. (CONF-870642—).

From 3. national conference on utility demand-side management programs: DSM strategies in transition; Houston, TX, USA (16 Jun 1987).

When evaluating the effectiveness of any demand-side management (DSM) program the load and energy impacts of the program must be measured. During the ElectriCREDIT pilot program, the Electric Utility will broadcast FM radio signals which will activate relays that interrupt (cycle) power to the ElectriCREDIT participants' air conditioners, strip heaters, water heaters, and pool pumps. The load impact (demand reduction) and energy impact (energy usage changes) of various appliance cycling strategies will be measured to evaluate their contribution to this DSM program. This paper focuses on the methods used to determine the load and energy impacts of the City of Austin's ElectriCREDIT direct load control pilot program. 2 figs., 4 tabs.

21782 (EPRI-EM—5452, pp 51.1-51.8, Section 51) **Load management opportunities in a period of increased utility demand-related costs.** Macphee, B.A. (Tennessee Valley Authority, Chattanooga (USA)). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920085/JAW. (CONF-870642—).

From 3. national conference on utility demand-side management programs: DSM strategies in transition; Houston, TX, USA (16 Jun 1987).

This paper explores some of the advantages for utilities to engage in load management programs. 4 refs., 6 figs. (JDH)

21783 (EPRI-EM—5452, pp 52.1-52.9, Section 52) **Evaluation of the General Service Efficiency Standards.** Bradley, R.D. (Seattle City Light, WA (USA)). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920085/JAW. (CONF-870642—).

From 3. national conference on utility demand-side management programs: DSM strategies in transition; Houston, TX, USA (16 Jun 1987).

This paper describes the General Services Efficiency Standards (GSES) program. GSES is an energy conservation regulatory program of Seattle City Light used to enforce energy saving measures in the utility's user community. (JDH)

21784 (EPRI-EM—5452, pp 53.1-53.10, Section 53) **Evidence on interruptible and curtailable service for electricity customers.** Herriges, J.A.; Hanser, P.; Caves, D.W.; Windle, R.J. (Laurits R. Christensen Associates, Inc., Madison, WI (USA); Electric Power Research Institute, Palo Alto, CA (USA)). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920085/JAW. (CONF-870642—).

From 3. national conference on utility demand-side management programs: DSM strategies in transition; Houston, TX, USA (16 Jun 1987).

The purpose of this paper is to discuss the results of a two-year study of interruptible/curtailable (I/C) service, sponsored by the Electric Power Research Institute (Project 2343). The study is based upon data from ten utilities offering I/C service and 150 customers that receive I/C service. The paper deals with two major customer response issues: methods for measuring the load impacts of I/C rates and the degree of customer compliance. Both issues are examined using data for customers on I/C rates. The evidence

suggests ways to design I/C service to achieve demand-side management objectives. 3 refs., 2 figs., 2 tabs.

21785 (EPRI-EM—5452, pp 54.1-54.9, Section 54) **Consumer preferences and the decision to participate in Southern California Edison's Demand Subscription Service Program.** Doxsey, L.B. (Caliper Corp., Newton, MA (USA)). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920085/JAW. (CONF-870642—).

From 3. national conference on utility demand-side management programs: DSM strategies in transition; Houston, TX, USA (16 Jun 1987).

Southern California Edison Company (Edison) operates a residential direct load control program known as the Demand Subscription Service (DSS) Program. The program is currently operating in a second experimental phase with participation voluntary among those households randomly selected to be approached as part of the experiment. The program's objective is primarily peak shaving, with control invoked only during times of system peak - hot summer afternoons. The chief characteristic distinguishing this program from other direct load control programs is that instead of the participating household accepting utility control over specific pieces of equipment, such as central air conditioning, they accept a restrictive maximum to their total household kilowatt demand during periods of program activation. In exchange for participating, regardless of actual activation experience, during each of the six summer months when the program is in effect, customers receive an incentive payment based on the difference between subscribed, restrictive demand maximum and an estimate of what their unconstrained demand would be. The incentive appears in the form of an itemized bill credit. This paper presents an econometric analysis of the factors determining consumer participation choice. 3 refs., 1 tab.

21786 (EPRI-EM—5452, pp 55.1-55.11, Section 55) **Estimating the market potential of alternative program features: PG and E's Residential Peak Load Reduction Project.** Baumgartner, R.M.; Amsden, S.L. (HBRS, Madison, WI (USA); Pacific Gas and Electric Co., San Francisco, CA (USA)). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920085/JAW. (CONF-870642—).

From 3. national conference on utility demand-side management programs: DSM strategies in transition; Houston, TX, USA (16 Jun 1987).

Pacific Gas and Electric Company's (PG and E) Residential Peak Load Reduction Project (RPLRP) was designed to reduce peak demand during summer months by cycling residential customers' central air conditioners off and on. Introduced in 1979 with 300 pilot customers, RPLRP now has 61,000 program participants - or about 8% of PG and E's residential central air conditioning customers. In 1986, air conditioners were cycled off for 15 minutes of each half hour between noon and 6 p.m. for a maximum of 20 days per year. To improve program cost-effectiveness, PG and E planned to adopt a "shed" strategy in which central air conditioners would be shut off for four consecutive hours, providing greater peak load reductions. This paper describes the results of a survey of customer acceptance of the cycle-to-shed program conversion and these other alternative program features: the size of the financial incentive, timing of the shut-offs, program operations criteria, and the number of months of program operation. Results will help PG and E develop the best mix of program features to maximize benefits to the company and maintain acceptable levels of program participation. 2 refs., 4 tabs.

21787 (EPRI-EM—5452, pp 56.1-56.10, Section 56) **Economic tests and reliability valuation for least-cost supply-demand integration.** Woychik, E.C. Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920085/JAW. (CONF-870642—).

From 3. national conference on utility demand-side management programs: DSM strategies in transition; Houston, TX, USA (16 Jun 1987).

This paper presents an evaluation of energy investment criteria (tests), a review of reliability valuation methods, and an approach for least-cost planning. The approach is defined with a view toward establishment of a set of investment criteria and a generalized method for least-cost planning which puts supply and demand options on a common basis, while explicitly considering the irreducible uncertainties we face. A Utility Least-Cost Test (ULCT) is recommended as the point for primary investment focus in the evaluation of all resource plan options. A rate impact measure test is recommended in lieu of the much-discussed nonparticipants or "no losers" test. Societal investment criteria are also presented. The paper concludes that least-cost resource planning and unbundling of utility services are essential to maintain utility viability in the face of increasing competition. 19 refs.

21788 (EPRI-EM—5452, pp 57.1-57.10, Section 57) **Integrating conservation resources into Texas certification proceedings, 1984 to 1987.** Treadway, N. (Public Utility Commission of Texas, Austin (USA)). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920085/JAW. (CONF-870642—).

From 3. national conference on utility demand-side management programs: DSM strategies in transition; Houston, TX, USA (16 Jun 1987).

While a variety of models and fairly comprehensive data have been examined in comparing electric utility supply options (the calculation of firm and non-firm payments for cogenerator supplied energy and demand is one example), the level of analysis of demand options has not kept pace. Only a few utilities in Texas are taking the collection of demand management data or the development of models to integrate demand and supply seriously. This paper reviews recent certification proceedings to contrast the state-of-the-art models on the horizon with the evidentiary hearing activities "in the trenches." Summaries of recent certification proceedings are preceded by a brief review of two other filing requirements of the commission. 3 refs., 1 tab.

21789 (EPRI-EM—5452, pp 58.1-58.6, Section 58) **Maine's path to least-cost planning.** Parker, R.B. (Maine Public Utilities Commission, Augusta (USA)). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920085/JAW. (CONF-870642—).

From 3. national conference on utility demand-side management programs: DSM strategies in transition; Houston, TX, USA (16 Jun 1987).

Electric utilities in the State of Maine have the luxury of choosing among a rich array of energy resources. The least-cost power supply mix today is much more diverse than that of a decade ago, a change resulting in part from changing production technologies and market conditions, in part from forward-looking federal and state legislation, and in part from an invigorating regulatory climate. While Maine rules and practice have been especially stimulating to the development of alternative power sources, they have consistently incorporated sound principles of least-cost generation planning. Demand-side achievements in Maine have been less dramatic to date, but utility pilot programs and recent regulatory innovations hold great promise for developing utility-planned energy conservation and load management into major elements of the energy resource mix. Pilot programs involving residential, commercial, and industrial customers have generated valuable experience and data, upon which foundation full-scale demand-side programs are now being built.

21790 (EPRI-EM—5452, pp 60.1-60.11, Section 60) **Why utility marketing procedures aren't as effective as they could be.** Mohler, B. (Battelle, Pacific Northwest Labs., Richland, WA (USA)). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920085/JAW. (CONF-870642—).

From 3. national conference on utility demand-side management programs: DSM strategies in transition; Houston, TX, USA (16 Jun 1987).

This paper discusses the reasons it is difficult for utilities to market energy conservation measures. Current state of mind in the United States is to "buy now" and "pay later." However, energy conservation requires the opposite, "pay now" and "enjoy later." The author states that this is one of the principal image problems with conservation programs. 7 refs., 11 figs. (JDH)

21791 (EPRI-EM—5452, pp 61.1-61.7, Section 61) **Marketing energy audits: Cost effectiveness of alternative methods for marketing commercial energy audits.** Prentice, W.C.; Nelson, H. (New York State Electric and Gas Corp., Binghamton (USA)). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920085/JAW. (CONF-870642—).

From 3. national conference on utility demand-side management programs: DSM strategies in transition; Houston, TX, USA (16 Jun 1987).

The Commercial Energy Audit Pilot Program was designed by New York State Electric and Gas (NYSEG) and Xenergy, Inc., to satisfy the New York State Public Service Commission requirement that all New York State Electric utilities spend a portion of their revenues on energy conservation research. This study was conducted to determine: (1) how successful an energy audit program can be in reducing a commercial customer's energy requirements; (2) how to effectively market a commercial audit program; and (3) the effect of audit pricing on the commercial customer's conservation efforts. This is a report of the findings from the Phase III marketing effort. Phase 3 of the project was implementation of the research design. A sample of NYSEG customers was selected to represent the NYSEG customer service regions and commercial building types. NYSEG customer representatives and Xenergy telemarketing personnel did the marketing and sold energy audits. (JDH)

21792 (EPRI-EM—5452, pp 62.1-62.11, Section 62) **Evaluation of demand-side management programs in Minnesota: Cost benefit analyses of utility CIP [Conservation Improvement Programs] programs.** Adiarte, A.L. (Minnesota Dept. of Public Service, St. Paul (USA)). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920085/JAW. (CONF-870642—).

From 3. national conference on utility demand-side management programs: DSM strategies in transition; Houston, TX, USA (16 Jun 1987).

The primary objective of this paper is to evaluate demand-side management (DSM) programs administered by electric utilities serving the State of Minnesota. Northern States Power Company (NSP), a summer peaking utility, and Otter Tail Power Company (OTP), a winter peaking utility, responded to a state mandate requiring electric and gas utilities to conduct cost-effective Conservation Improvement Programs (CIP). The Energy Division of the Minnesota Department of Public Service is responsible for evaluating the cost-effectiveness of these programs. A secondary objective of this study is to perform sensitivity analyses involving critical factors, which include: cost and timing of capacity additions, market penetration rate, discount rate, and the magnitude of energy and demand savings. Uncertainty in these factors significantly affects the outcome of the cost-benefit analysis. 1 ref., 4 tabs.

21793 (EPRI-EM—5452, pp 63.1-63.8, Section 63) **What's right and wrong with cost-benefit tests for demand-side resources.** Mitchell, C.K. (State of Nevada Attorney General's Office of Consumer Advocate, Reno (USA)). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920085/JAW. (CONF-870642—).

From 3. national conference on utility demand-side management programs: DSM strategies in transition; Houston, TX, USA (16 Jun 1987).

Proper consideration of energy efficiency as a utility resource should occur in the context of least cost utility planning (LCUP). The concept and general specifications of LCUP are by now familiar to virtually all those involved in the electric utility business. Generally stated, the LCUP process is both a regulatory framework and a utility planning procedure. Under LCUP the utility strives to ensure that future load growth is met with reliable and adequate energy services provided at the least possible cost. This paper discusses the importance of evaluating and implementing energy efficiency in the context of LCUP. The framework for the discussion was developed as follows: first, the means by which energy efficiency has been evaluated and implemented prior to the advent of LCUP is reviewed; next, the discussion turns to an examination of the changing nature of energy efficiency evaluation and implementation since the advent of LCUP. Contrasts between the two approaches are drawn. With that as a foundation, the body of the paper considers whether the various methods currently used to evaluate the economics of energy efficiency are adequately considering the requirements of LCUP.

21794 (EPRI-EM—5452, pp 64.1-64.16, Section 64) **Integrated analysis of demand-side programs: A case study of the Texas Utilities Electric Company.** Eto, J.H.; Koomey, J.G.; McMahon, J.E.; Kahn, E.P. (Lawrence Berkeley Lab., CA (USA)). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920085/JAW. (CONF-870642—). Contract AC03-76SF00098.

From 3. national conference on utility demand-side management programs: DSM strategies in transition; Houston, TX, USA (16 Jun 1987).

This paper describes an integrated analysis method used to evaluate the load shape and economic consequences of a demand-side programs (DSP) for residential appliances. The method employs a "bottom-up" approach that includes end-use forecasts of annual energy use for all fuels and of hourly loads for electricity. The forecasts are based on an engineering/economic model that uses energy prices and demographic data. The financial analyses rely on avoided production costs based on utility avoided cost filings. These benefits are compared to costs for both the utility and society. The utility's costs are the under-recovered fixed costs resulting from "lost" electricity sales. Society's costs are the incremental labor and capital costs of the demand-side activity. Our method is particularly well-suited to analyses of energy conserving demand-side technologies, but is not presently capable of modeling other important DSPs such as time-of-use pricing and direct load control technologies. 17 refs., 3 figs., 5 tabs.

21795 (EPRI-EM—5452, pp 65.1-65.11, Section 65) **Integrated utility planning using UPLAN.** Fatula, J.F.; Koved, M.D. Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920085/JAW. (CONF-870642—).

From 3. national conference on utility demand-side management programs: DSM strategies in transition; Houston, TX, USA (16 Jun 1987).

In response to a more competitive environment, electric utilities are developing strategies to maintain market share. In order to remain competitive with other fuels and to avert the threat of bypass, utilities have begun to adopt a strategy referred to as least-cost planning. Some utility planners and analysts maintain that utilities have always followed a least-cost path, due to regulatory mandates. The term least-cost planning has, however, been associated with a broader range of considerations than were examined in traditional supply-side planning. The distinction between traditional planning and least-cost planning is that the planner has a wider set of investment options available to include within the portfolio. The newest among the planner's tools are sets of programs which are designed to affect the customer's side of the meter. In the most general terms, these options have been referred to as demand-side management (DSM). One purpose of this paper is to describe an integrated demand-side/supply-side financial planning system called UPLAN. 4 figs.

21796 (EPRI-EM—5452, pp 66.1-66.10, Section 66) **An integrated, least-cost planning model for utilities in power pools.** Molodetz, S.C.; Bubb, S.R. (Niagara Mohawk Power Corp., Syracuse, NY (USA); D.F.I. Electric Power Software, Minneapolis, MN (USA)). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920085/JAW. (CONF-870642—).

From 3. national conference on utility demand-side management programs: DSM strategies in transition; Houston, TX, USA (16 Jun 1987).

With capacity-short utilities facing nervous customers and soaring construction costs, and capacity-long utilities facing pressure to utilize reserves and reduce costs, demands for new marketing initiatives or conservation programs, as the case may be, are now routine. Utility planners have been frustrated because data and modeling limitations have not allowed credible cost-benefit comparisons of these new demand-side management (DSM) programs with traditional supply options. The problem is compounded for

utilities operating in a power pool or holding company. Recognizing that supply-side methodologies set the standard for management acceptance of new resource or marketing plans, Niagara Mohawk Power Corporation (NMPC) has invested substantial resources into the design and implementation of a sophisticated new demand-side planning capability that can meet those high standards and achieve credibility within the utility's planning infrastructure. Central to this effort was the redevelopment and enhancement of the Electric Power Research Institute's (EPRI) integrated demand-side planning tool, the Load Management Strategy Testing Model (LMSTM). This paper describes the enhanced multi-company version of LMSTM and illustrates its analytical power with a sample program assessment. 5 refs., 8 figs.

21797 (EPRI-EM—5452, pp 67.1-67.12, Section 67) **Integrated electric planning using the trade off/risk method.** Burke, W.J. (Power Technologies, Inc., Schenectady, NY (USA)). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920085/JAW. (CONF-870642—).

From 3. national conference on utility demand-side management programs: DSM strategies in transition; Houston, TX, USA (16 Jun 1987).

21798 (EPRI-EM—5452, pp 68.1-68.11, Section 68) **The rate structure as a tool for demand management.** Mather, N. (Ontario Hydro, Toronto (Canada)). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920085/JAW. (CONF-870642—).

From 3. national conference on utility demand-side management programs: DSM strategies in transition; Houston, TX, USA (16 Jun 1987).

Demand management can be defined as actions intended to influence the amount or timing of customers' use of electricity. The purpose of influencing timing or total consumption is generally to hold down the cost of energy usage over the long term, while allowing for an appropriate level of reliability and minimizing environmental impacts. It is a helpful analogy to think of the rate structure as a "tool" which can be used for demand management. It is perhaps more accurate to think of it as a tool kit, with a variety of rate structures which are useful for various purposes. Several tools can be used in combination. Some are usually thought of as being applied in a mandatory way, others as voluntary. Furthermore, some of the tools are suitable for most or all customers, whereas others have narrow suitability. This paper begins by describing four rate-making objectives developed in Ontario, and analyzes recent rate restructuring proposals with respect to them. Ten rate structures are then described in terms of their relevance for demand management and their impact on other objectives. Finally, some conclusions are drawn concerning rate structures which might be favored if demand management were made a more important objective in relation to the other rate-making objectives which are currently dominant.

21799 (EPRI-EM—5452, pp 69.1-69.15, Section 69) **Innovative and flexible strategies for demand-side management using dynamic pricing.** Sanghvi, A.P. (Hagler, Bailly and Co., Washington, DC (USA)). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920085/JAW. (CONF-870642—).

From 3. national conference on utility demand-side management programs: DSM strategies in transition; Houston, TX, USA (16 Jun 1987).

This paper highlights the need for and potential role of flexible pricing options which offer an efficient means for achieving a utility's load/demand management objectives. In particular, the focus of this paper is on dynamic tariffs. By incorporating real time features within one or more key parameters of the tariff, such pricing options can be tailored to offer the degree of flexibility that is necessary and cost effective for achieving the given demand management objective(s). 19 refs.

21800 (EPRI-EM—5452, pp 70.1-70.8, Section 70) **Evaluating time-of-use rates by estimating baseline time-of-use consumption.** Larson, S.M.; Hoffman, M.G. (New England Power Service Co., Westborough, MA (USA)). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920085/JAW. (CONF-870642—).

From 3. national conference on utility demand-side management programs: DSM strategies in transition; Houston, TX, USA (16 Jun 1987).

In June 1986, the New England Electric System (NEES) launched a load management program in its Rhode Island retail subsidiary, The Narragansett Electric Company. This program, the Customer Load Control Project (CLC), includes an innovative time of use rate experiment designed to test customer reaction to high energy prices during a short peak period. As the summer system peak traditionally occurs on weekdays between 12 noon and 4 p.m., the Load Management Rate (LMR) incorporates a peak period of 11 a.m. to 5 p.m. on weekdays and an off-peak period to include all other hours during the billing months July through October. It was anticipated that the short peak period would provide customers with more ability to shift load than the longer peak periods seen in the majority of TOU rates. The LMR is voluntary and available to residential, industrial, and commercial customers. The peak versus off-peak price differential is 11.3 cents for all classes. This paper centers on the residential portion of the LMR experiment. 2 figs.

21801 (EPRI-EM—5452, pp 71.1-71.15, Section 71) **Corporate culture and the changing utility industry.** Bowles, D. (Hay Group, Inc., Los Angeles, CA (USA)). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920085/JAW. (CONF-870642—).

From 3. national conference on utility demand-side management programs: DSM strategies in transition; Houston, TX, USA (16 Jun 1987).

This paper describes the corporate environment of electric utilities. The influence of this environment on decision making, marketing, and planning is emphasized. 2 figs., 2 tabs. (JDH)

21802 (EPRI-EM—5452, pp 72.1-72.3, Section 72) **TU Electric: Organizing to ensure the integration, conservation and load management programs in a resource planning process.** Buck, L.E. Jr. (Texas Utilities Services, Inc., Dallas (USA)). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920085/JAW. (CONF-870642—).

From 3. national conference on utility demand-side management programs: DSM strategies in transition; Houston, TX, USA (16 Jun 1987).

This paper discusses the merger of two Texas electric utilities. Merger as a strategy for efficient demand-side marketing is emphasized. (JDH)

21803 (EPRI-EM—5452, pp 73.1-73.8, Section 73) **Managing demand management at Ontario Hydro.** MacCarthy, D. (Ontario Hydro, Toronto (Canada)). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920085/JAW. (CONF-870642—).

From 3. national conference on utility demand-side management programs: DSM strategies in transition; Houston, TX, USA (16 Jun 1987).

This paper describes Ontario Hydro's use of demand-side management ideas. A strategy for integrated marketing resource planning is presented. 2 figs. (JDH)

21804 (EPRI-EM—5452, pp 74.1-74.7, Section 74) **Demand-side management: A view from Wall Street.** Barnes, S.A. (The First Boston Corp., New York, NY (USA)). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920085/JAW. (CONF-870642—).

From 3. national conference on utility demand-side management programs: DSM strategies in transition; Houston, TX, USA (16 Jun 1987).

This paper describes some of the economic forces causing electric utilities to engage in demand-side management activities. (JDH)

21805 (EPRI-EM—5452, pp 75.1-75.5, Section 75) **Utility demand-side management: An overview and perspective.** Fenn, S. (Investor Responsibility Research Center, Washington, DC (USA)). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920085/JAW. (CONF-870642—).

From 3. national conference on utility demand-side management programs: DSM strategies in transition; Houston, TX, USA (16 Jun 1987).

This paper presents a critical review of demand side management programs. The review is based on the findings of a recent survey of 123 electric utilities. (JDH)

21806 (EPRI-EM—5452, pp 76.1-76.7, Section 76) **Demand-side management in a changing industry.** Fitzpatrick, D.R. (Dept. of Energy, Washington, DC (USA)). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920085/JAW. (CONF-870642—).

From 3. national conference on utility demand-side management programs: DSM strategies in transition; Houston, TX, USA (16 Jun 1987).

This paper discusses some of the reasons it is important for the electric power industry to engage in demand-side management. The roles of conservation and regulatory reform for planners of demand-side management are reviewed. (JDH)

21807 (EPRI-EM—5632) **DSM [demand-side management]: Market research issues and methods: Final report.** George, S.S.; Feldman, S.; Kirksey, W.E.; Skelton, J.C. (XENERGY, Inc., Oakland, CA (USA); Opinion Research Corp., Princeton, NJ (USA); Battelle Columbus Div., OH (USA)). Feb 1988. 73p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920212/JAW.

To aid utilities in developing effective DSM programs, EPRI has undertaken a major project to improve and integrate pertinent tools, methods, and data for application to DSM. Numerous efforts were conducted among nine major areas of the DSM planning process. This report provides a brief overview of some of the technical issues and research techniques associated with DSM.

21808 (IAEA-TECDOC—433, pp 11-112) **VALORAGUA - A model for the optimal management of a hydro-thermal power system.** Baptista, V.; Tavares, M.N. (Electricidade de Portugal, Porto, Portugal. Dept. de Planeamento de Centros Produtores). Oct 1987. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88701434/JAW. (CONF-8611222—).

From Advisory group meeting to review progress in improving the WASP-III computer model and methodology for nuclear power planning in developing countries; Vienna, Austria (4 Nov 1986).

This paper describes the VALORAGUA model for the optimal management of the operation of hydro/thermal systems. From a mathematical standpoint, the optimal expansion of an electric power system is a multidimensional stochastic sequential decision problem of high complexity. The objective is to minimize a discounted sum of investment plus generation costs over a prescribed time horizon. In each period of the time horizon, the decision maker has to choose between the value of immediate use of water measured by the corresponding economy of "fuel", as against a later use of the water measured in terms of future benefits. The paper also presents a mathematical formulation of the problem as well as a case study description and some applications of the model. (author). 20 refs, 2 figs, 5 tabs.

21809 (IAEA-TECDOC—433, pp 113-127) **Improvements in the current version of the WASP-III model.** Teixeira, A.S. (Electricidade de Portugal, Porto, Portugal. Dept. de Planeamento de Centros Produtores). Oct 1987. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88701434/JAW. (CONF-8611222—).

From Advisory group meeting to review progress in improving the WASP-III computer model and methodology for nuclear power planning in developing countries; Vienna, Austria (4 Nov 1986).

This paper describes the principal improvements made to the latest version of WASP, the WASP-III computer model, according to the contract between EDP and the IAEA. The improvements introduced in the WASP-III model increase the memory requirements of both the simulation and report writer by about 10% and 34% respectively. The increase in CPU time is only marginal when compared to the total CPU time taken to obtain the optimal solution. (author). 13 tabs.

21810 (IAEA-TECDOC—433, pp 129-148) **ENPEP and the microcomputer version of WASP-III: Overview and recent experience.** Buehring, W.A.; Wolsko, T.D. (Argonne National Lab., IL, USA). Oct 1987. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88701434/JAW. (CONF-8611222—).

From Advisory group meeting to review progress in improving the WASP-III computer model and methodology for nuclear power planning in developing countries; Vienna, Austria (4 Nov 1986).

Argonne National Laboratory (ANL) has developed a microcomputer-based energy planning package entitled ENergy and Power Evaluation Program (ENPEP). It consists of seven technical modules, four commercial software packages, and an executive system that conveniently integrates the many options associated with performing energy studies. The seven technical modules and their functions are as follows: MACRO allows the user to specify macroeconomic growth (global or sectoral) that will be the drivers of energy demand. DEMAND projects energy demand based upon the macroeconomic growth information supplied in MACRO. PLANTDATA provides a library of technical data on electric generating plants that is used by BALANCE and ELECTRIC. BALANCE computes marketplace energy supply/demand balances over the study period. LOAD computes detailed electric load forecast information for use in ELECTRIC. ELECTRIC, the microcomputer (PC) version of WASP-III, calculates a minimum cost electric supply system to meet electric demand and reliability goals. IMPACTS calculates environmental impacts and resource requirements associated with energy supply system options. ENPEP provides the potential for energy planners in developing countries to carry out important studies without access to inconvenient and/or expensive mainframe computers. The ELECTRIC module of ENPEP provides electric system planners the opportunity to use the WASP-III model for expansion planning of electrical generating systems. Extensive efforts have been made in converting WASP-III to the microcomputer to provide user-friendly data entry forms and options for operations. (author). 3 refs, 20 figs.

21811 (IAEA-TECDOC—433, pp 149-178) **Electric power system operation simulating programme package "ELBIVIM".** Sajovic, D. (Electroinstitut Milan Vidmar, Ljubljana, Yugoslavia). Oct 1987. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88701434/JAW. (CONF-8611222—).

From Advisory group meeting to review progress in improving the WASP-III computer model and methodology for nuclear power planning in developing countries; Vienna, Austria (4 Nov 1986).

The paper illustrates problems at representing the available energy production in hydro power stations in a form, as it is needed for the application in an electric energy planning model. In this the electric system operation simulating programme package "ELBIVIM" is described, which has been developed in the north western region of Yugoslavia, where the part of electric energy, produced in hydro power plants with only small storages, is particularly great. (author). 7 figs, 1 tab.

21812 (IAEA-TECDOC—433, pp 179-189) **Electric energy balance model KR70.** Jansson, B.; Nordlund, P. (Kraangede Power Pool, Stockholm, Sweden; Swedish State Power Board, Vaellingby). Oct 1987. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88701434/JAW. (CONF-8611222—).

From Advisory group meeting to review progress in improving the WASP-III computer model and methodology for nuclear power planning in developing countries; Vienna, Austria (4 Nov 1986).

The computer program KR70 for electric energy balance calculations is designed for detailed modelling of power systems, especially those containing hydro power. The program was developed in the beginning of the seventies by the private power industry in Sweden and has since then been used for operation and expansion planning in Sweden. Power systems comprising hydro or thermal power or combined systems can be analysed by the model. This paper begins with a general survey of model demand on input data. Long term (seasonal) optimization, comprising calculation of water value curves and long term simulation, is carefully described as the next step. Finally short term (weekly) simulation is briefly explained. (author). 10 figs.

21813 (IAEA-TECDOC—433, pp 191-201) **Modelling system interconnections using WASP.** Rozali, bin M.A. (National Electricity Board, Kuala Lumpur, Malaysia). Oct 1987. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88701434/JAW. (CONF-8611222—).

From Advisory group meeting to review progress in improving the WASP-III computer model and methodology for nuclear power planning in developing countries; Vienna, Austria (4 Nov 1986).

The paper describes the use of WASP as a modelling tool for examining the long term development of two or more power systems with interconnections. Two case studies are outlined, one with interconnections serving primarily for capacity sharing, and the other with an interconnection modelled as a means of base-load energy transfer. (author). 2 figs, 2 tabs.

21814 (IAEA-TECDOC—433, pp 203-222) **Composite generation/transmission expansion planning.** Pereira, M.V.F. (Centro de Pesquisas de Energia Eletrica, Rio de Janeiro, Brazil). Oct 1987. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88701434/JAW. (CONF-8611222—).

From Advisory group meeting to review progress in improving the WASP-III computer model and methodology for nuclear power planning in developing countries; Vienna, Austria (4 Nov 1986).

This paper describes a methodology for automated generation/transmission expansion planning, based on mathematical decomposition techniques. Network analysis is based on the linearized power flow model (DC load flow). Steady-state network performance indices such as circuit overloads are "translated" into loss-of-load related indices such as minimum load curtailment (MIC). This allows a consistent comparison of generation and transmission reinforcements in the system. (author). 20 refs, 3 figs, 2 tabs.

21815 **(NEDO-P—8634) Survey of electric load management system in USA.** (New Energy Development Organization, Tokyo (Japan)). Mar 1987. 231p. (In Japanese). NTIS (US Sales Only), PC A11. Order Number DE88770070/JAW.

Published data and information available at present are collected to carry out comprehensive examination and analysis of the electric load management systems adopted in U.S. with respect to their background, objectives, adoption procedures, implementation plans, institutional grounds and expected future improvements, and also to the views held or measures taken by the Federal Government, state authorities, electric utilities and consumers. Another survey is based on case studies performed at three electric power companies, Consumers Power, Pacific Gas and Electric Power, and Potomac Electric Power. Questionnaires and interviewers are carried out to examine the electric load management systems adopted in these companies, centering on details of the systems, implementation procedures, evaluation of them by the companies, future plans, and measures taken by consumers, including large users such as manufacturing plants, in response to these systems. (10 figs, 20 tabs)

2980 Consumption And Utilization

REFER ALSO TO CITATION(S) 21000, 21835, 21904

2990 Unconventional Sources And Power Generation

REFER ALSO TO CITATION(S) 21210, 21211, 21260, 21262, 21263

21816 **(PB—88-136544/XAB) Evaluation of energy sources for roadside rest areas. Research report (Interim).** Rock, B.A.; Vliet, G.C. (Texas Univ., Austin (USA). Center for Transportation Research). Dec 1986. 125p. (CTR—3-18-86-442-2). NTIS, PC A06/MF A01.

The study investigates the conventional and alternate energy sources for roadside rest areas. Conservation, solar-thermal, photovoltaics, and natural lighting are described, as are other factors which influence energy usage. The analysis of alternate energy systems using computer codes is also discussed. Recommended solutions to energy needs are presented throughout the report.

30 DIRECT ENERGY CONVERSION

3001 Mhd Generators

REFER ALSO TO CITATION(S) 23938, 23939

21817 **(DOE/ET/15601—25) Diagnostic development and support of MHD [magnetohydrodynamics] test facilities: Technical progress report for the period April, May, June 1986.** Shepard, W.S.; Cook, R.L. (Mississippi State Univ., Mississippi State (USA). MHD Energy Center). Jul 1986. Contract AC02-80ET15601. 56p. NTIS, PC A04. Order Number DE88005301/JAW.

Mississippi State University is developing diagnostic instruments for MHD power train data acquisition and for support of MHD component development test facilities. Microprocessor-controlled optical instruments are being refined and new systems to measure temperatures and gas-seed-slag stream characteristics are being developed. To further data acquisition and analysis capabilities, the diagnostic systems are being interfaced with MHD Energy Center computers. Additionally, technical support of the diagnostic needs of the national MHD research effort is being provided. 10 refs., 19 figs., 4 tabs.

21818 **(MHD—D131) A general 2D electrical model for diagonally connected MHD generators.** Daniel, V.W. (MSE, Inc., Butte, MT (USA)). Dec 1987. Contract AC07-78ID01745. 32p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004283/JAW.

A general 2D electrical model for diagonally connected MHD generators has been developed that solves for the steady state electric fields inside the channel and throughout the external network with a minimum of assumptions on the nature of the generator. Nonuniformities on the cathode wall and slag leakage on all walls enter naturally into the mathematical formulation. The mathematical model treats external networks of arbitrary complexity, including those with current controllers and power shufflers. The finite element computer model simulates the effects of arcing on the electrode walls and calculates the cathode wall shorting pattern via the current reversal mechanism. Data generated by the electrical model simulating the Component Development and Integration Facility (CDIF) 1A generator is compared to experimental data. 11 refs., 8 figs., 2 tabs.

21819 **Performance characteristics of nonequilibrium disk type MHD generators for rankine cycles using cesium-seeded mercury vapor.** Inui, Y.; Ishikawa, M.; Umoto, J.; Campbell, R.B.; Logan, B.G. (Dept. of Electrical Engineering, Kyoto Univ.). pp 53-54 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

The authors studied a new type of generator configuration, which is named "disk-type generator with separated channels". In this generator, the walls which separate each channel are made of segmented electrode, which preserves sufficient swirl to allow a larger pressure ratio and enthalpy extraction. For a cathode/anode radius of 2.7 m/1.5 m, inlet Mach number = 3, inlet stagnation temperature 3000°K, inlet static pressure = 0.5 atm, 8T uniform magnetic field, and 10/sup -3/ cesium seed fraction, an enthalpy extraction (not including the latent heat of vaporization of mercury) of 43.5% for single electrode pairs, and 48.5% for multi-electrode pairs.

3005 Fuel Cells

REFER ALSO TO CITATION(S) 20801, 20804, 21349

21820 **(DOE/ER/13066—3) Catalysis of direct methanol electro-oxidation in buffered electrolytes: Final report for the period July 15, 1983 to January 14, 1987.** Rupich, M.W.; Brummer, S.B.; Galligan, D.A.; Kingsley, S.C.; Mardis, E.L. (EIC Labs., Inc., Norwood, MA (USA)). Oct 1987. 49p. NTIS, PC A03. Order Number DE88001659/JAW.

Aqueous potassium carbonate-potassium bicarbonate solutions were evaluated as electrolytes for the direct oxidation of methanol. The potassium carbonate-potassium bicarbonate electrolyte was examined at temperatures from 80 to 175°C and steam pressures up to 6 atmospheres. Pt/Ni, Pt/MoS_2, Pt/Fe_2O_3, Pt/Ru and Pt/Sn were identified as potential catalysts for the direct oxidation of methanol in a potassium carbonate-potassium bicarbonate electrolyte. Evaluation of these materials in half cells at temperatures of 175°C indicated potential stability problems with long term use. A preliminary evaluation of oxygen reduction in the potassium carbonate-potassium bicarbonate electrolyte showed that the performance of a methanol-air fuel cell would be limited by the activity of the cathode. 29 figs.

21821 **(LA-UR—88-100) Recent advances in solid polymer electrolyte fuel cell technology.** Ticianelli, E.A.; Srinivasan, S.; Gonzalez, E.R. (Los Alamos National Lab., NM (USA); Sao Paulo Univ., Sao Carlos, SP (Brazil). Inst. de Fisica e Quimica). 1988. Contract W-7405-ENG-36. 15p. (CONF-880468—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005380/JAW.

From 6. Brazilian symposium on electrochemistry and electroanalytical chemistry; Sao Paulo, Brazil (1 Apr 1988).

With methods used to advance solid polymer electrolyte fuel cell technology, we are close to obtaining the goal of 1 A/cm^2 at 0.7. Higher power densities have been reported (2 A/cm^2 at 0.5 V) but only with high catalyst loading electrodes (2 mg/cm^2 and 4 mg/cm^2 at anode and cathode, respectively) and using a Dow membrane with a better conductivity and water retention characteristics. Work is in progress to ascertain performances of cells with Dow membrane impregnated electrodes and Dow membrane electrolytes. 5 refs., 6 figs.

21822 **(NEDO-P—8512) Feasibility study on diversified fuels for molten carbonate fuel.** (New Energy Development Organization, Tokyo (Japan)). Mar 1986. 247p. (In Japanese). NTIS (US Sales Only), PC A11. Order Number DE88770055/JAW.

The adaptability of fuels including natural gas, methanol and LPG to the molten carbonate fuel cell by reforming methods was examined. These fuels can be reformed by steam reforming. Since these fuels except methanol contain sulphur compounds, they must be treated by an appropriate desulphurization process to prevent the reforming catalyst from poisoning. The optimum steam/carbon ratio must be chosen to minimize the deposition of carbon on the catalyst. The power generation system was investigated by varying the reforming method, power generating capacity (10 and 100MW) and fuel. The generating efficiency of a 10MW-power plant using the external reforming method is 56.5 to 56.8% independently of the fuel, while that using the internal reforming method is 53.1 to 57.5% in the order of natural gas, methanol and LPG. (95 figs, 43 tabs)

21823 (NEDOJ—8401, pp 675-689) **Development of phosphoric acid fuel cell power generation system. Dispersed generation (low temperature and low pressure type).** Aug 1984. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770050/JAW.

In FY 1983 NEDO Annual Report.

The following investigation was conducted to develop elemental technologies for low-temperature, low-pressure fuel cell power generation systems and perform basic design of a 1 MW class power generation plant. The first theme is on cell technology, including the method of optimal adjustment of electrode catalyst, the electrode structure, the matrix adjustment method, optimization of the separators, the phosphoric acid application method, and cell configuration. As a result, an average cell voltage of 0.711 V was achieved. The second theme is on lamination technology, including clamp structure, sealing technology, and cooling technology. Tests were conducted on a model consisting of cells with an effective electrode area of 3600 cm^2 laminated into 21 layers. The tests showed that the target characteristic values were achieved. The third theme is study of elemental technologies, including pressure conbustion and dynamic system characteristics. The fourth theme is the basic design of a 1 MW class plant. Process design, thermal balance, and mass balance were investigated. It has been revealed that a power generation efficiency of 40.2% can be accomplished. (9 figs, 2 tabs)

21824 (NEDOJ—8401, pp 690-705) **Development of phosphoric acid fuel cell power generation system. Substitute thermal power plant.** Aug 1984. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770050/JAW.

In FY 1983 NEDO Annual Report.

Aiming to develop a fuel cell power generation system as a substitute of a thermal power plant, investigation was conducted for research and development of elemental technologies for high-temperature, high-pressure fuel cell power generation systems and for the basic design of a 1 MW class power generation plant. The investigation themes were as follows: The first theme is research and development of cell technology, including study of phosphate storage technology, development of electrode materials together with study of phosphate scattering, and development of matrix materials. The second theme is research and development of lamination technology, including study of clamp structure, development of sealing and cooling technologies, and study of gas flow. The third theme is study of elemental technologies for fuel reforming equipment, including study of combustion technology and reforming technology. The basic design of a 1 MW class power plant was performed using the results of the development activities above. The basic design has revealed that a power generation efficiency at site of 42.3% can be accomplished. (19 figs, 1 tab)

21825 (NEDOJ—8702, pp 284-290) **Research and development of phosphoric acid fuel cell power generation system. Research and development of distributed type fuel cell power generation system (low-temperature and low-pressure type).** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770076/JAW.

In FY 1986 NEDO annual report (Part 2).

The purpose of this study is to construct a 1 MW-phosphoric acid fuel cell low-temperature and low-pressure power generation system as the distributed power source and to confirm the performance of each system and seize the characteristics of system by the operation of the plant. The basic design of system was completed in FY1984 and the manufacturing of the fuel cell and the components and the installation of a part of facilities in the site of Sakai-Minato Power Plant of Kansai Electric Power Co. were completed in FY1985. In FY1986, the following preadjustment of each subsystem was carried out: the combustion test of burner; the pressurized heating test and the natural gas reforming test in the fuel reforming system; the startup test of the turbo-compressor in the pneumatic system; the overall preadjustment of the plant using a dummy stack; the installation of fuel cell; and assembling of total system. Thus, the construction of the plant was completed. The operation manual of the plant and the safety management manual were compiled. The overall adjustment test operation is being made according to the manuals. (4 figs, 1 tab)

21826 (NEDOJ—8702, pp 291-297) **Research and development of phosphoric acid fuel cell power generation system. Research and development of power generation system alternative to thermal power plant (high-temperature and high pressure type).** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770076/JAW.

In FY 1986 NEDO annual report (Part 2).

The purpose of this study is to construct a 1 MW-phosphoric acid fuel cell high-temperature and high-pressure power generation system and to seize the characteristics of system and establish the operational technique by the operation of the plant. In FY 1985, the fuel cell was manufactured and tested and the reforming facilities and controller were manufactured and installed in the site of Chita No. 2 Thermal Plant. In FY 1986, the following preadjusting test (PAC test) of each subsystem was performed: the start-up of turbine-compressor and the test of control characteristics by pneumatic systems; the startup and shutdown tests of the cell cooling water system; and the determination of reforming properties and the switching operation of fuel to the main burner in the reforming system. It was confirmed that every system demonstrates the specified performance. Load analysis as the overall test of these systems is being made using a dummy stock. The construction of the whole equipment has not been completed yet because of the prolonged test period. (5 figs, 1 tab)

21827 (NEDOJ—8702, pp 298-299) **Research and development of phosphoric acid fuel cell power generation system. Study on total system.** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770076/JAW.

In FY 1986 NEDO annual report (Part 2).

The phosphoric acid fuel cell power generation system was investigated for optimizing the total system viewing from the standpoints of capacity, configuration, utilization, environment, safety and economics. In FY 1985, the target specifications were compiled from the system configuration and environmental and economic impacts and the representative specifications corresponding to the operational purpose and scale were also compiled. In FY 1986, the demand patterns of power and heat in an intermediate service area from several MW to several tens MW were analyzed to investigate the system configuration for applying the waste heat from the fuel cell to the district heating and cooling. The technical and economic impacts derived from the introduction of fuel cell were compiled and the analytical program for a part of it was developed to evaluate the benefits. From the results were determined the critical construction unit costs of the plants for the power source alternative to a thermal power plant, distributed power source and on-site power source. (1 tab)

21828 (NEDOJ—8702, pp 300-307) **Development of comprehensive technology of phosphoric acid fuel cell. Research and development of fuel cell power plant for solitary island.** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770076/JAW.

In FY 1986 NEDO annual report (Part 2).

The purpose of this study is to manufacture a 200 kW-phosphoric acid fuel cell power plant for the electric power used in a solitary island and to perform the test operation. The five-year program was initiated in 1986. In FY 1986, the requisite technology for various components was developed and the specifications were decided. Among the components, a large combined-electrode was made on an experimental basis and the characteristics of partial models of the fuel cell using the electrode were evaluated. The experimental facilities for heating the catalyst by a heating medium and for burning the off-gas were manufactured to obtain the basic data and a 50 kW- reforming test equipment was constructed. Tokashiki Island in Okinawa Prefecture was selected as the plant site and the demand and main bed of power in the island was surveyed on the spot. The specifications of plant and the process flow were decided. (2 figs, 2 tabs)

21829 (NEDOJ—8702, pp 308-314) **Development of comprehensive technology of phosphoric acid fuel cell. Research and development of commercial fuel cell power generation system.** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770076/JAW.

In FY 1986 NEDO annual report (Part 2).

The purpose of this study is to develop a down-sized, easy operation phosphoric acid fuel cell power generation system as a commercial on-site power source for hotel and hospital and to operate the system. The five-year program was initiated in 1986. In FY 1986, the component research such as the moulding process of sheet matrix and electrode for thinner cell and the determination of performance of heat pipe cooler were made. The structure of down-sized reformer and heat-exchanger were investigated. The three-dimensional impeller, material of impeller, gaseous bearing and the structure of soundproof package of the high-performance turbo compressor were studied to determine the basic structure. Hotel A with the floor space of appromixately 50,000 m^2 was selected to install the system and the demands of power and heat were surveyed. The specifications of a 200 kW-outdoor system were developed based on those results. (2 tabs)

21830 (NEDOJ—8702, pp 315-327) **Research and development of molten carbonate fuel cell power generation system. Study on experimental construction and operation of power plant (matrix type electrolytes).** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770076/JAW.

In FY 1986 NEDO annual report (Part 2).

The purpose of this study is to establish the component technology for developing a large-capacity molten carbonate fuel cell and to construct a 10 kW-fuel cell on an experimental basis. The study has been continued since 1981. In FY 1986, the component materials and manufacturing processes were successively studied and improved. A large, microporous, tough electrode plate was manufactured by the improved manufacturing process of doctor-blade and paper machine. Corrosion-resistant Al-and Y-added Cr-Ni steel was developed for the material of separator. The structure of separator of cell and the advantages of the cascade gas-cooling system of it was confirmed. In the experiment of a 10 layer-laminated cell with the electrode area of 3600 cm^2 each, the output was 4.2 kW. A cell with thee blocks of the laminated cell successfully generated the output of 12.4 kW. (10 figs, 2 tabs)

21831 (NEDOJ—8702, pp 328-337) **Research and development of molten carbonate fuel cell power generation system. Study on experimental construction and operation of power plant (paste type electrolytes).** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770076/JAW.

In FY 1986 NEDO annual report (Part 2).

The purpose of this study is to establish the component technology of a large-capacity molten carbonate fuel cell and to develop a 10 kW-fuel cell. The study has been continued since 1983. In FY 1986, the component materials, manufacturing processes and lamination technique were successively studied and improved. The paste electrolyte layer was manufactured on an experimental basis by the continuous moulding process using a heating roll. A moulding process of the material of cathode from powdered Ni was developed. A surface oxidizing method of stainless steel was developed to improve the corrosion resistance of the material of separator. The catalyst supporting method and composite catalyst for reforming process were investigated. The flow rate and temperature of gas in a heat transfer model of large cell stack were measured to obtain the design data of the lamination structure of stuck in the area of lamination technique. In the experiment of a large-scaled, 63 layer-laminated cell with the electrode area of 1600 cm^2 each, the output record was 10.8 kW. (7 figs, 2 tabs)

21832 (NEDOJ—8702, pp 338-342) **Research and development of molten carbonate fuel cell power generation system. Study on total system.** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770076/JAW.

In FY 1986 NEDO annual report (Part 2).

The evaluation test method of a 10 KW-molten carbonate fuel cell was decided and the configuration of cogeneration system was investigated. The research has been continuously performed since 1984. The findings in FY 1986 are as follows: 1) Evaluation test of a 10 KW-stack: the initial function including gas-sealing performance was confirmed; the initial performance such as the cell and stack voltage was tested; the characteristics of gas utilization

including the performance of gas distribution and cooling were determined as one of the indispensable items; and the target of the performance of test stack was decided; and 2) Cogeneration combined cycle: the carbon deposition, gas cycle and operational conditions in the case using LNG as the fuel were investigated; the guideline for optimizing the configuration of cogeneration system was made; and the fundamental guide of operational management of the system was prepared judging from the viewpoints of safety and environmental control. (1 fig, 2 tabs)

21833 **Solubilities of LiFeO/sub 2/ and (Li, K)/sub 2/ CrO/sub 4/ in molten alkali carbonates at 650°C.** Hsu, H.S.; DeVan, J.H.; Howell, M. (Oak Ridge National Lab., Oak Ridge, TN 37831). *Journal of the Electrochemical Society;* 134: No. 9, 2146-2187(Sep 1987). Contract AC05-84OR21400.

The equilibrium solubilities of LiFeO/sub 2/ and (Li,K)/sub 2/CrO/sub 4/ in 62% Li/sub 2/CO/sub 3-/38% K/sub 2/CO/sub 3/ were determined at 650°C under controlled oxidizing conditions simulating those of molten carbonate fuel cells. Both materials appear to dissolve by a nonredox dissolution process, since the solubilities of LiFeO/sub 2/ and (Li,K)/sub 2/CrO/sub 4/ are independent of the partial pressures of CO/sub 2/ and O/sub 2/ over the ranges studied. Equilibrium solubilities of LiFeO/sub 2/ and (Li,K)/sub 2/CrO/sub 4/ in the carbonate mixture were determined to be 78 wppm of iron and 13.7 weight percent of chromium, respectively.

32 ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

REFER ALSO TO CITATION(S) 21207

21834 **(ECRC/M—2203) Retrospective steam flowmetering.** Bertinat, M.P. (Electricity Council Research Centre, Capenhurst (UK)). Nov 1987. 9p. Electricity Council Research Centre, Capenhurst, Chester, CH1 6ES, UK.

Detailed metering of steam usage is becoming increasingly important, and the desire to install steam flowmeters in pre-existing pipework ('retrospective installation') is growing accordingly. The types of flowmeter commonly used for steam are here reviewed, followed by a brief discussion of their use in retrospective applications. It is argued that there would be a substantial market for a simple 'clip-on' steam flowmeter if one could be developed.

3201 Buildings

REFER ALSO TO CITATION(S) 21014, 21351, 21352, 21371, 21675, 21724, 21730, 21735, 21931, 21932, 22367, 22583, 22585, 22588, 22589, 22591, 22595, 22598, 22601, 22607, 22608, 22611, 22627, 22628, 22632, 22634, 22636, 22637, 22638, 22639, 22640, 22642, 22645, 22650, 22653, 22654, 22655, 22656, 22657, 22665, 22667, 22763, 22766, 22770, 22774, 22781, 22783, 22787, 22791, 22794, 22876, 22995, 23005, 23006, 23007, 23008, 23153, 23163, 23167, 23168, 23170, 23172, 23186

21835 **(AD-A—187129/2/XAB) Analysis of military-family-housing energy consumption. Master's thesis.** Jones, W.L. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Systems and Logistics). Sep 1987. 106p. (AFIT/GEM/DEM—87S-12). NTIS, PC A06/MF A01.

This study had two objectives: to determine whether energy consumption was comparable between MFH and non-MFH residences and to determine the feasibility of appreciably decreasing MFH energy consumption. The study found energy consumption tended to be greater in MFH. However, most of this difference is probably due to factors beyond the occupants' control such as house size, house construction, and equipment efficiency. Energy consumption in MFH and non-MFH residencies tended to be comparable under near equal conditions. Decreasing MFH energy consumption involves increasing the housing units' efficiency and decreasing the occupants' energy consumption. Increasing MFH energy efficiency can be accomplished by using more efficient equipment and appliances and using proper construction materials and techniques to reduce heat loss, heat gain, and number of air changes. These efforts result in a net energy and monetary savings as well as increased occupant comfort.

21836 **(AFME—84-0588) Preliminary study to experimentations of climatic houses in Guadeloupe and Cameroon.** (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). 1986. 172p. (In French). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88752268/JAW.

The objective of this study was to develop a simplified design method for residential buildings in warm and humid tropical climate. The characteristics of the building and climate in those two countries are first described. Then experiments have been conducted concerning the heat transfers in a tropical house (roof, wall, etc.). The experimental results are used to develop algorithms for simulation and optimization of tropical buildings. It is shown how important the roof is in the thermal balance of the house.

21837 **(CONF-871113—5) Volatile organic compounds in indoor air: Types, sources, and characteristics.** Gammage, R.B.; Matthews, T.G. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 23p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005065/JAW.

From American Institute of Chemical Engineers annual meeting; New York, NY, USA (15 Nov 1987).

Examples are given of occupant activities and consumer and construction products inside residences that cause transient and persistent emissions of volatile organic compounds (VOC). Transient emissions arise from window cleaning, carpet laying, smoking, and automobile operations. Persistent VOC emitters include gasoline, mothballs and pressed-wood products containing urea-formaldehyde resins. Simple screening methods are given for making indoor measurements of VOC. Detailed laboratory and research house studies of formaldehyde emissions decay from pressed-wood building products are described. 14 refs., 4 figs., 3 tabs.

21838 **(CONF-871203—2) A comparison of two techniques for monitoring the field thermal performance of roof systems.** Courville, G.E.; Childs, P.W.; Moazed, A.R.; Derderian, G.D.; Stewart, G.D.; Shu, L.S. (Oak Ridge National Lab., TN (USA); Grace (W.R.) and Co., Cambridge, MA (USA)). 1987. Contract AC05-84OR21400. 29p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006417/JAW.

From Conference on insulation materials, testing and applications; Bal Harbour, FL, USA (6 Dec 1987).

Two independent techniques, one intrusive and one non-intrusive, for monitoring the thermal performance of in-situ roof systems (roofing materials) are compared. The intrusive technique requires thermocouples on inside and outside surfaces of the roof system and a heat flux transducer (HFT) embedded in the system. The non-intrusive procedure has the same thermocouple placement and a series of HFTs on the inside surface of the deck. The crucial difference in the methods is in the HFT placement and the technique for HFT calibration. Results of a one-year field study using both methods on the same roof assembly are described. The roof assembly is a built-up roof with molded expanded polystyrene (EPS) insulation above a metal deck. 13 refs., 10 figs., 1 tab.

21839 (DOE/ER/60493—1-Vol.1, pp 728-734) **Investigations on individual indoor humidification.** Voelksch, G.; Horn, H.; Guenther, A. (Institute of General Hygiene, Erfurt, Germany, F.R.). 1987. NTIS, PC A 99. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Air humidification devices and equipments are among the sources dispersing numerous germs into the indoor air. In their water reservoirs germinate typical water-germs as well as hydrophile microorganisms, such as Pseudomonas and Klebsiella, capable to cause hospital infections. If there is a massive contamination of the indoor air, diseases may occur. Air humidifers are compared and evaluated from a hygienic and microclimatic point of view.

21840 (DOE/ER/60493—1-Vol.2, pp 267-271) **Determination of the impact of infiltration reduction measures on house air leakage.** Sheldon, L.S.; Saeger, M.L.; Cox, B.G.; Smith, M.L.; Hartwell, T.D.; Rizzuto, J. (Research Triangle Institute, Research Triangle Park, NC). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The purpose of this study was to measure the direct impact that caulking and weatherstripping of windows and doors and installation of storm windows and storm doors had on house leakage in two counties in New York State. House leakage was estimated for 60 homes by performing blower door measurements with and without the weatherization measures in place. The overall reduction in house leakage resulting from both weatherization procedures was 17%. Generally, the effect of caulking/weatherstripping was greater than the effect of storm doors/windows. Homes in Onondaga County appeared to show a greater overall effect than homes in Suffolk County. Older homes appeared to show a greater overall effect than new homes. Over recent years, there has been increased emphasis on energy conservation through weatherization programs that control air leakage in and out of the house. As weatherization becomes more popular and methods for minimizing air leakage becomes greater. An overall goal of the research program was to obtain information for guiding conservation programs and for providing information to homeowners so as to achieve maximum conservation potential while ensuring that the implementation of conservation measures is compatible with the maintenance of acceptable indoor air quality.

21841 (DOE/ER/60493—1-Vol.2, pp 454-458) **Mechanical ventilation in an office building and sick building syndrome. A short-term trial.** Jaakkola, J.J.K.; Heinonen, O.P.; Seppaenen, O. (National Public Health Institute, Helsinki, Finland). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The effects of mechanical ventilation on the sick building syndrome were evaluated in an office building with 2150 employees. The ventilation rate was known to be high in the building. The main hypothesis put forward was that reducing the rate of mechanical ventilation would alleviate symptoms. A short-term trial was carried out by shutting off the ventilation in one part of the building, reducing it in two areas and leaving one part unaltered as a control. The reduction of ventilation had if any, an opposite effect that was anticipated. There was a linear correlation between increase in symptoms and rise in room temperature to above 22°C.

21842 (DOE/ER/60493—1-Vol.3, pp 3-7) **Lorena stoves acceptance and household environment improvement in Guatemala.** Caceres, A.; Caceres, E. (San Carlos Univ., Guatemala). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The lorena stove (LS) is a monolythic stove designed for Mesoamerican cooking conditions, based on local availability of construction materials and inspired on the need for a more efficient combustion. After ten years of diffusion in the Mesoamerican region and several known failures in other parts of the world, the LS has shown limited potential for a massive dissemination, although all the evaluatory surveys conducted in the country indicate that social and comfort qualities were the main reasons for adoption of the new cooking technology, instead of the need for saving energy by the population as expected. Since new improved stoves are being developed, it is very important to design them on a participative approach, and taking into consideration all sort of social, cultural and economical parameters, besides the thermodynamical and commercial considerations.

21843 (DOE/ER/60493—1-Vol.3, pp 62-67) **Neglected environmental human requirements in Ethiopian traditional houses.** Befekadu, F. (Addis Abeda Univ., Ethiopia). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The provision of a healthy and comfortable indoor environment is a factor of great importance. This paper investigates the influence of windows on daylight penetration, thermal and smoke conditions, psychological aspects and animal odor concentrations in interiors. Based upon subjective response the investigation was carried out in 7 different types of Ethiopian traditional houses. Assessment results indicate that of the two traditional houses with windows one registered a scale of 4 on all the five assessed factors where the other showed a scale of 2 on four of the assessed factors. In the windowless traditional houses, however, residents showed different scales on all the assessed factors; 92% expressed the desire to have windows and 85% were against building separate shelter for domestic animals.

21844 (DOE/ER/60493—1-Vol.3, pp 90-94) **Thermal performance and emission characteristics of biomass burning heavy stoves with chimneys.** Joshi, V.; Venkataraman, C.; Ahuja, D.R. (Tata Energy Research Institute, New Delhi, India). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The thermal and environmental performance of two fixed, chimney stoves was evaluated by simulating in the laboratory, conditions that mimic the common errors observed in large scale dissemination programs. The major parameters studied were thermal efficiency (n) and, emissions of carbon monoxide (CO) and total suspended particulates (TSP). A significant decline in efficiency was observed due to a common construction flaw and also due to a common operational practice of leaving the dampers open. Venting the chimney out resulted in removing 80-88% of the CO and 60-75% of the TSP from the room. Venting the chimney inside the room led to higher emissions of CO per task for the stove studied than for unvented metal stoves burning the same fuel.

21845 (DOE/ER/60493—1-Vol.3, pp 152-156) **Ventilation and indoor air quality.** Seppaenen, O.A. (Helsinki Univ. of Technology, Espoo, Finland). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

A large project was conducted in Finland to evaluate the present indoor air quality, climate and ventilation and to establish new criteria for ventilation and indoor climate. Great differences were found out in the ventilation rates and operation of HVAC systems. In general indoor air quality was good. More problems were found out in the thermal climate. In many cases the HVAC system didn't satisfy the variation of the loads of the rooms. As a result of the project some recommendations for good indoor air quality was given. The most important of those were the optimum temperature 21 - 22°C and maximum air speed 0.1 m/s during the heating season. The ventilation rates should depend on occupancy being 7 - 8 liters/s per person, however, the minimum ventilation rate should not be less than 0.4 air changes per hour.

21846 (DOE/ER/60493—1-Vol.3, pp 165-169) **Computer-controlled system for measuring building air exchange rates using sulfur hexafluoride as a tracer gas.** Alevantis, L.E.; Hayward, S.B. (Air and Industrial Hygiene Lab., Berkeley, CA). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

A computer-controlled system for measuring air exchange rates in large buildings has been developed. The system consists of

a data acquisition unit controlled by a personal computer, a gas chromatograph equipped with a molecular sieve column and a scandium-tritium electron capture detector, a weather station, and a carbon dioxide analyzer. The system is capable of monitoring up to sixteen different locations, automatically calibrating itself, and displaying ventilation rates at the end of the sampling period. One of the important features of this system is that oxygen is prevented from entering the electron capture detector, thus reducing the time between samples and extending the life of the detector.

21847 (DOE/ER/60493—1-Vol.3, pp 170-174) **New concept of air distribution in operating room.** Bugaj, A. (Technical Univ. of Wroclaw, Poland). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Experiments have been carried out in order to determine the minimum amount of air needed to produce a virtually sterile environment and find an optimum air distribution system. The system proposed in the paper can create sterile environment in the operating zone and its vicinity with minimum amount of supply air. For the other studied schemes of air distribution the conditions are less favorable at the same air exchange rates. And in order to have a sterile environment in the operating zone - which means that clean air should not mix with contaminated air - in other systems the air exchange rates should substantially exceed the value for the proposed system.

21848 (DOE/ER/60493—1-Vol.3, pp 175-179) **Designing office buildings for improved environmental quality.** Cole, R.J.; Sterling, E.M. (Univ. of British Columbia, Vancouver). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Responsive action to the issue of environmental quality in buildings has so far been limited to revised maintenance and operation procedures and, in some instances, the re-design of mechanical systems in problem buildings. Alternative solutions involving major architectural renovation and the implications of air quality concerns on new architectural design strategies have yet to be explored. This paper identifies and discusses five emerging issues that must be addressed before a more fundamental architectural response will occur: an acceptance and comprehension of the air quality problem; a reassessment of the premise of current environmental design strategies; access to, and assimilation of, reliable information; the justification of alternative design solutions and redefinition of costs; and the co-ordination of members of the design team.

21849 (DOE/ER/60493—1-Vol.3, pp 203-208) **Fan standards in clean-room technology.** Hagenbruch, D. (NOVENCO GmbH, Cologne, Germany, F.R.). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Increasingly, clean-rooms are becoming the indispensable prerequisites for progress in the miniaturization of electronic components, for the more and more sophisticated technologies in surgery and intensive medicine as well as for the increasingly complex chemistry in the pharmaceutical industry. Clean-room technology with laminar air flow requiring appropriate air filtration at extreme air exchange rates has posed considerably problems not only to the constructors and operators of such systems but also to the fan manufacturers.

21850 (DOE/ER/60493—1-Vol.3, pp 209-213) **Impact of HVAC operation and leakage on ventilation and intercompartment transport: studies in a research house and 39 Tennessee valley homes.** Matthews, T.G.; Thompson, C.V.; Monar, K.P.; Dudney, C.S.; Hawthorne, A.R.; Harper, J.P.; Williams, A.B. (Oak Ridge National Lab., TN). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3). Contract AC05-84OR21400.

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Forced-air heating, ventilation, and air conditioning (HVAC) systems caused an average and maximum increase in air infiltration rates of 1.8- and 4.3-fold in 42 occupied houses and one unoccupied research house. An average increase in air infiltration rate of 0.33 +/- 0.37 h^{-1} corresponds to an air leak of 260 m^3/h, accounting for approximate house volume. Twofold to fourfold increases in air infiltration rates with HVAC operation in the research house were reduced to less than twofold by sealing of the external HVAC unit and crawlspace ductwork system. Such sealing also resulted in a 30% reduction in crawlspace –> indoor transport rates under HVAC on conditions. However, blower door tests indicated a <20% reduction in house leakage area.

21851 (DOE/ER/60493—1-Vol.3, pp 214-218) **Evaluation of performance of VAV system in super energy conservation building.** Tanaka, T. (Ohbayashi Corp., Tokyo, Japan). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

This paper describes the performance of the VAV System installed in the Super Energy Conservation Building. The concentrations of CO, CO_2 and dust were examined when the tightness of the VAV System was changed. A survey of occupants by questionnaire was also made. The results of the examinations and the survey were the following. (1) Good temperature and air current distributions were obtained even when the VAV System was throttled down. (2) The concentration of dust increased when the VAV System was closed tighter. The minimum air volume of the VAV System, considered from the concentration of dusts, is suitable at 6 to $8m^3/h.m^2$. (3) It is useful for energy conservation to control the minimum air volume of the VAV System upon detection of dust concentration.

21852 (DOE/ER/60493—1-Vol.3, pp 226-230) **Performance of electrostatic precipitators in restaurants.** Kimmel, J. (Tampere Univ. of Technology, Finland). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Restaurant workers are in many cases exposed occupationally to environmental tobacco smoke. Electrostatic precipitators are often used to reduce the tobacco smoke particulate concentration in restaurants. This investigation was conducted to assess the performance of electrostatic precipitators in realistic field conditions. A survey was made in eleven restaurants, seven of which were then fitted with room-size electrostatic precipitators. Their performance was followed for several contiguous weeks. The results show a decrease of 20 to 50% in the particle mass concentrations in most cases. Regular cleaning of the precipitators was found to be essential for ensuring proper functioning of the devices.

21853 (DOE/ER/60493—1-Vol.3, pp 283-287) **Development of a desiccant based air conditioners with indoor pollution control capabilities.** Novosel, D.; Relwani, S.M.; Moschandreas, D.J. (Gas Research Institute, Chicago, IL). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Application of heating, ventilation, and refrigeration systems to control living and working conditions has enhanced comfort conditions and has measurably increased productivity. Recent energy conservation measures have made buildings tighter and have exacerbated concerns about potential indoor air pollution. This paper reviews the development effort of a desiccant based air conditioner. The gas-fired desiccant dehumidifier (along with particulate filtration) may not only provide improved thermal comfort, but also superior indoor air quality (IAQ) control. It is concluded that the desiccant based system is economically viable and shows excellent promise for enhanced comfort conditioning and air quality control.

21854 (DOE/ER/60493—1-Vol.3, pp 294-298) **How to build a healthy house.** Sammaljaervi, E. (National Public Health Institute, Helsinki, Finland). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

All buildings cannot be or become homes. The safest way to ensure a healthy house is first to minimize the environmental pollutant sources in the surroundings. Simple guidelines are presented to build a good house. With a careful planning your healthy home does not cost any more than a failed one. Guidelines are based on experience, findings from an epidemiological study, and a literature review.

21855 (DOE/ER/60493—1-Vol.3, pp 301-306) **Air quality and ventilation efficiency in residential and office buildings.** Antti, M.; Tapio, H.; Olli, S. (Helsinki Univ. of Technology, Espoo, Finland). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The paper presents the results from field measurements concerning the air-exchange efficiency in various buildings. Measurements were carried out with a tracer gas technique and a decay method in 15 office and residential buildings with different air distribution systems. The average air-exchange efficiency varied between 36% and 57% in office buildings and between 34% and 50% in dwellings. A short circuiting of air between supply and exhaust ducts decreased most often the average air-exchange efficiency. The nominal time constant varied between 0.2 h and 3.5 h in the tests and differed a lot from design values. Extensive measurements were made in a test room under laboratory conditions in order to find out the performance of various air distribution systems and the relation between indices used to describe the ventilation.

21856 (DOE/ER/60493—1-Vol.3, pp 307-312) **Experimental comparison of indoor climate using various air distribution methods.** Holmberg, R.B.; Folkesson, K.; Stenberg, L.G.; Jansson, G. (Flaekt Evaporator AB, Joenkoeping, Sweden). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Several air distribution methods were analyzed on an experimental basis at Flaekt's Indoor Climate Center in Stockholm for the purpose of studying thermal comfort as well as air quality. The tests were conducted in a typical office module (15 m^2) during three cooling load situations: summer (45 W/m^2), spring/autumn (25 W/m^2) and winter (4 W/m^2). Climate data from the Stockholm area were used in all three cases. Test results were reported for jet-controlled air distribution with slot air diffusers, and for thermally controlled air distribution with wall-mounted as well as floor-mounted air supply devices.

21857 (DOE/ER/60493—1-Vol.3, pp 313-318) **Ventilation effectiveness and ADPI measurements of three supply/return air configurations.** Offermann, F.J.; Int-Hout, D. (Indoor Environmental Engineering, San Francisco, CA). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The two purposes of a building ventilation system are (1) to remove indoor contaminants and (2) a provide thermal comfort. Ventilation effectiveness is measured using tracer gas techniques and age distribution theory to compare the actual delivery rates of outside air at specific locations to those projected for the case of perfect mixing. ADPI is a thermal comfort parameter which compares the effective draft temperature as determined by dry bulb temperatures and air speeds to acceptability criteria established by ASHRAE. Three different supply/return configurations were evaluated for a recirculating constant volume system in a steady heating mode under standard conditions for an office space. Ventilation effectiveness ranged from 0.57 to 0.76 at points in the occupied zone. ADPI measurements ranged from 81 to 94%. Short circuiting of supply air to the return air inlet was evident in tests of each configuration. More research is required to characterize the performance of existing systems and develop more effective ventilation strategies.

21858 (DOE/ER/60493—1-Vol.3, pp 319-323) **Ventilation efficiency in clean rooms.** Larsson, B.; Neikter, K.; Strindehag, O. (Flaekt Svenska AB, Stockholm, Sweden). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

An experimental study of the ventilation efficiency has been carried out in a clean room with vertical airflow. Special interest has been devoted to the ventilation efficiency in the working zone when the heat load, the vertical air velocity and the arrangement of the workplace were varied. The results show that high values of the ventilation efficiency can be achieved, provided that due attention is paid to the air movements in the working zone.

21859 (DOE/ER/60493—1-Vol.3, pp 324-328) **Detailed evaluation of range-exhaust fans.** Nagda, N.L.; Koontz, M.D.; Fortmann, R.C.; Billick, I.H. (GEOMET Technologies, Inc., Germantown, MD). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Use of range-exhaust fans during cooking can be important in improving indoor air quality, provided that the fans are vented to the outside of residences. Little is known about the actual prevalence of kitchen fans in the United States or about fan usage patterns in residences. To fill this information gap, a nationwide survey of 3000 households was conducted. Complementary research performed in two unoccupied test houses provided information about the effects of vented fans on combustion contaminants associated with gas range operation.

21860 (DOE/ER/60493—1-Vol.3, pp 329-333) **Turbulent air flow measurements in ventilated spaces.** Kovanen, K.; Seppaenen, O.; Siren, K.; Majanen, A. (Helsinki Univ. of Technology, Espoo, Finland). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The purpose of the present study is to investigate the characteristics of turbulent air flow in the occupied zone of ventilated spaces: air velocity, standard deviation, turbulence intensity and fluctuation frequency. The study is accomplished by making field measurements in dwellings and offices with various ventilation and air distribution systems. Rooms with only most typical supply and exhaust devices were chosen to the study. In each space probes were placed at least at three locations in the occupied zone. At each location, measurements were performed at four heights: 0.05, 0.15, 1.1 and 1.7 m above the floor level. The relationship between the mean velocity and the standard deviation was calculated at every four heights. The instrumentation was designed and built in the laboratory of heating, ventilating and air conditioning of Helsin-

ki University of Technology. In order to analyze fluctuation frequencies a computer program, that uses Fast Fourier Transform method, was develop. The paper will comprise the summary of results and discuss the influence of air distribution and ventilation system on the measured factors.

21861 (DOE/ER/60493—1-Vol.3, pp 337-341) **Pressure inside buildings - a dominant parameter for calculating effective natural ventilation.** Baechlin, W. (Univ. of Karlsruhe, Germany, F.R.). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

For the calculation of air exchange and effective ventilation of buildings the difference between the external and internal pressure induced by wind is an important dominant parameter. Whereas the external pressure has been investigated rather extensively, very little progress has been made in the reassessment of internal pressure in buildings. By a systematical study the internal pressure inside of different cubical buildings was determined in a boundary layer wind tunnel. The approach flow characteristics were scaled to correspond to typical natural conditions. The shape of buildings, the opening ratio, epsilon, and the porosity, μ, were varied in order to determine their influence on the mean internal pressure. The relationship between epsilon, μ and the mean internal pressure is demonstrated.

21862 (DOE/ER/60493—1-Vol.3, pp 342-346) **Natural shaft ventilation - measurement, simulation, contribution to basic ventilation.** Fail, A.; Panzhauser, E. (Technical Univ., Vienna, Austria). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Extremely low air flow values have been found in newly constructed buildings with very tight envelopes. Very low rates of air flow through ventilation shafts are often caused by extreme high resistances of tight windows and doors. The exact determination of the chain of flow resistance factors, beginning with those of the building envelopes (of the building elements forming the envelope) through inner space up to the shaft heads, permits us to carry out realistic calculations of the efficiency of air infiltration and of shaft ventilation; this efficiency depends on the kind of window and door construction and on their position respectively. An enhanced algorithm is mentioned.

21863 (DOE/ER/60493—1-Vol.3, pp 347-351) **Air outlets for displacement flow and their influence on flow pattern with various kinds of heat sources.** Fitzner, K. (Heinrich Nickel GmbH, Betzdorf/Seig, Germany, F.R.). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Displacement flow is enabled by air outlets which inject the air with a very low and unidirectional velocity. The flow pattern in the room is mainly influenced by the kind and distribution of heat sources in the room. In recent years displacement flow has become and more popular, as a type of flow in air conditioned spaces. Three main tasks, namely to save energy, to improve comfort, and ventilation efficiency were the main reasons to think about the advantages of this flow.

21864 (DOE/ER/60493—1-Vol.3, pp 352-356) **Relations of air humidity in dwellings at different ventilation systems (natural and mechanical).** Hain, K.; Truemper, H. (Univ. of Dortmund, Germany, F.R.). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

In the research and demonstration project Duisburg and in an other apartment house on the same location had been measured temperatures, air humidities and in a part of the dwellings the opening times of the windows. There were different ventilation systems in the apartments. Seven dwellings had a central balanced ventilation system with heat recovery - one of these dwellings was not occupied for reference -, one apartment had only mechanical exhaust air for the kitchen and the interior sanitary rooms, which are situated in the center of the dwelling and therefore don't have windows and eight dwellings with the same ground plan and natural exhaust air to the principle of Berliner-ventilation. The different values of measurements during a significant period will be shown as figures.

21865 (DOE/ER/60493—1-Vol.3, pp 367-372) **Influence of turbulent wind on ventilation.** Narasaki, M.; Yamanaka, T.; Higuchi, M. (Osaka Univ., Japan). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

One of the problems in the design method of wind forced ventilation is that the influence of turbulent wind on ventilation is not taken into account. The most notable example is that the ventilation rate of a room with a single opening subjected to turbulent wind can not be predicted. The need to establish the design method allowing for the turbulence of wind is stated and its conceptional flow chart is presented. The air flow rates through a single opening of model enclosure subjected to artificial wind are measured by tracer-gas method stirring the air inside the enclosure in order to investigate the effect of various factors (mean air velocity, turbulent intensity, opening area, incident angle of wind) upon the air flow rate. In addition, the air flow rates computed with the theoretical model of pulsation are compared with the measured values.

21866 (DOE/ER/60493—1-Vol.3, pp 373-377) **Evaluation of low-cost tracer techniques for measuring air exchange rates in buildings.** Niemelae, R.; Aalto, H.; Tossavainen, A. (Institute of Occupational Health, Helsinki, Finland). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The aim of this study was to find and evaluate a simple detector or method for routine air exchange rate measurements in dwellings and office buildings. The experimental work was mainly focused on evaluating a semiconductor sensor for the detection of freon 12 (dichlorodifluoromethane). The applicability of carbon dioxide indicator tubes for air exchange measurements, CO_2 as a tracer gas, was also studied. It was found that these methods can be used only when an approximation is sufficient.

21867 (DOE/ER/60493—1-Vol.3, pp 378-383) **Conversion of a natural draught ventilation system to mechanical exhaust with heat pump - a case study.** Norell, L. (Flaekt Indoor Climate AB, Stockholm, Sweden). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Examples of upgrading of natural draught ventilation systems in existing multi-family houses are given in this paper. One example describes the installation of a supply and exhaust air system with heat recovery. Another example describes the installation of a mechanical exhaust air system in which the existing brickwork ducts have been successfully utilized. A heat pump for the domestic hot water recovers heat from the exhaust air. In this example, measurements show that growing problems due to damp and mold have been solved by improved ventilation. The total energy consumption has decreased due to the exhaust air heat pump.

21868 (DOE/ER/60493—1-Vol.3, pp 383-387) **Increased ventilation efficiency in rooms.** Olsson, H. (Hugo Theorells Consulting Engineers, Malmoe, Sweden). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The ventilation efficiency in a room can be improved by means not used much so far. For a couple of years the author has made studies and tests of a new efficient method for lowering the contamination level in a room. The method is based on the fact that a supply air stream with high induction characteristics will draw secondary air to the outlet. The secondary air containing a maximum amount of contaminants and having a higher temperature than the primary air has, is the most desirable to exhaust in a room. In any type of ventilation system in a room, the supply-exhaust air diffuser or register will considerably increase the ventilation efficiency in the room.

21869 (DOE/ER/60493—1-Vol.3, pp 388-392) **Influence of airflow on the performance of the perfluorocarbon tracer technique for measuring ventilation rates.** Vercammen, M.; Leaderer, B.P.; Dietz, R.N. (Peutz and Associates, Nimwegen, Netherlands). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The perfluorocarbon tracer technique (PFT) is being extensively used for determining air infiltration rates in residences and office buildings. The method has been evaluated in chamber studies for effects of temperature, variable ventilation rates and orientation of the passive capillary collectors in low air velocities (< 0.2m/s) typical of residences. This paper presents the results of chamber studies designed to evaluate the PFT method under conditions of constant temperature and high air velocities (0.8 to 6.4 m/s). The efficiency of the passive capillary collectors was evaluated as a function of air velocity and orientation in the flow. Two different enclosures for the collectors, designed to minimize the air velocity effects, were also evaluated. The results indicate that air velocities above 0.8 m/s and collector orientation affect the efficiency of the collectors. Enclosing the collector and orienting if 180° to the flow minimizes the effect.

21870 (DOE/ER/60493—1-Vol.3, pp 395-398) **Attempt to define thermal comfort for severely compromised patients on artificial respiration.** Ohgke, H.; Trommler, T.; Beckert, J. (Medical Univ. Luebeck, Germany, F.R.). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

In a field study we measured mean skin temperature (MST) of 44 traumatized patients with elevated rectal temperature at various ambient temperatures (radiant and dry air temp.) ranging from 21 to 29°C. As in healthy persons MST rose with increasing ambient temperature but not as a parallel at higher degrees of temperature. Postulating an increase in metabolic rate of 100% vs. healthy persons we allocated a zone of thermal comfort at MST of 33,2 - 34,7°C and ambient temperatures of 22 - 26°C (relative humidity 30-70%, air velocity not exceeding 0,2 m/s).

21871 (DOE/ER/60493—1-Vol.3, pp 409-413) **Estimation of thermal environment in a naturally ventilated room with windows opened by using data from full-scale measurements.** Ishii, A.; Katayama, T.; Tsutsumi, J.; Nishida, M.; Sakakibara, N. (Kyushu Institute of Design, Fukuoka, Japan). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The questionnaire inquiry conducted shows that cross-ventilation is used in 70-80% of apartment houses in the daytime of summer. The authors also carried out the simultaneous measurements of indoor climate in the two dwellings, one with windows opened and another with windows closed. Comparison of PMV of the two makes clear thermal effect of cross-ventilation. Nomogram for estimating indoor PMV from any outdoor climatic conditions can be made up by using relations between outdoor and indoor meteorological factors.

21872 (DOE/ER/60493—1-Vol.3, pp 429-435) **Indoor thermal climate in shops and stores.** Kaehkoenen, E.; Ilmarinen, R. (Institute of Occupational Health, Helsinki, Finland). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Thermal discomfort, especially due to draft, is the most common complaint of the indoor climate in shops and stores. Thermal parameters of importance for thermal comfort were measured continuously in 13 shops and stores during the working day in winter and in summer and the workers rated their subjective thermal sensations. The insulation of clothing and metabolic rate were evaluated and the correlations between calculated PMV and subjective ratings were calculated. This study indicates that thermal discomfort in shops and stores is caused more by low air temperatures, great differences in vertical air temperature, and cold but low air velocities, than by high radiant temperature asymmetry or high mean air velocities. The collected data were used for developing a set of functional work clothing.

21873 (DOE/ER/60493—1-Vol.3, pp 439-442) **Floor drafts from cold walls.** Berglund, L.G.; Fobelets, A.P. (Yale Univ., New Haven, CT). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Cold perimeter walls can cause air motion across the adjacent floor and result in draft discomfort to the feet of occupants. Air velocity and temperature measurements made in a room with one cold wall 2.3 m in height resulted in expressions to predict the air's speed and temperature near and along the floor caused by the cold wall. Combining these expressions with recent draft discomfort results enables the percentage of persons likely to experience draft discomfort near unheated perimeter walls to be estimated. The results indicate the conditions within 2 m of a perimeter wall under which a substantial number of occupants will feel a floor draft in winter.

21874 (DOE/ER/60493—1-Vol.3, pp 443-447) **Relative humidity, temperature and subjective perception of dry air.** Goethe, C.J.; Ancker, K.; Bjurstroem, R.; Holm, S.; Langworth, S. (Dept. of Occupational Medicine, Stockholm, Sweden). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

108 persons working in four large offices reported their subjective perception of temperature and humidity on visual analogue rating scales. The temperature and relative humidity were measured with an Assman psychrometer. Within the temperature and humidity spans of respectively 20.4 - 24.3°C and 15-36% there was observed a tendency to decreasing humidities with increasing temperatures at the workplaces of the men, but not at those of the women. For the women, the relative humidity correlated negatively with the subjective evaluation of humidity. At the current conditions, the subjective sensation of dry air seems mainly to depend on other conditions than the water content of the air.

21875 (DOE/ER/60493—1-Vol.3, pp 448-451) **Operative temperature - the most suitable way for practical civil engineering.** Halahyja, M.; Pirsel, L. (Slovak Technical Univ., Bratislava, Czechoslovakia). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Fanger's thermal comfort theory evaluates the indoor climate of buildings with regard to the predicted activity and clothing worn by the occupants. A disadvantage from the designer's view is

that the present approach does not sufficiently characterize the interior's variety and the physiological demands of the occupants. The aim, therefore, was to simplify Fanger's exact formulas and to apply the thermal comfort theory when creating temperature criteria for the evaluation of the indoor temperature.

21876 (DOE/ER/60493—1-Vol.3, pp 457-460) **New COMECON standard for thermal comfort within residential and civic buildings.** Jokl, M.V. (Technical Univ., Prague, Czechoslovakia). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

A new Comecon standard for thermal comfort within residential and civic buildings is based on the Complex System of Evaluation of Hygro-Thermal Microclimate starting from an exact mathematical model of the indoor environment. Not only optimal parameters are predicted, but also admissible values and their ranges, i.e. their possible changes - also the requirements for the sensitivity of the heating, ventilation and air conditioning controls.

21877 (DOE/ER/60493—1-Vol.3, pp 461-465) **Experimental results of an influence of air and radiant temperatures on men thermal sensations in flats.** Lakomy, T. (Technical Univ., Wroclaw, Poland). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The work concerns an influence of selected microclimate elements on subjective thermal votes of men in large-panel blocks flats. An influence of thermal asymmetry has also been discussed. Results suggest the calculation of operative temperature using subjective temperature factors for air velocities $\leqq$ 0.2 m/s.

21878 (DOE/ER/60493—1-Vol.3, pp 466-470) **Archetypes of environmental tempering: the cultural significance of indoor air quality.** Lord, D. (California Polytechnic State Univ., San Luis Obispo). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Cultural values dating back to antiquity are the basis for modern social attitudes towards indoor air quality. Classical knowledge of climate and the environmental tempering of building interiors is part of the common cultural inheritance of Europe and the United States. Values relating to air quality and climate are reflected both in our literature and in our buildings. Structuralist analysis of literature and architecture reveals the archetypes behind the design of well-tempered spaces.

21879 (DOE/ER/60493—1-Vol.3, pp 471-475) **Air velocity and thermal comfort.** Mayer, E. (Fraunhofer-Institut fuer Bauphysik, Holzkirchen, Germany, F.R.). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Complaints about draft rank first among complaints about thermal discomfort in rooms. The aim of this paper is to elucidate the correlations between the physical characteristics of air velocity and of thermal comfort. Draft as a unwanted local convective cooling of a person, physically has to be investigated by evaluating the convective surface heat transfer coefficient. The method to do this and some results are described. But which values of this coefficient are unwanted. This is answered by the help of a physical and physiological view. It contains the dry heat balance of a person and the reaction of the coefficient on its surface temperature.

21880 (DOE/ER/60493—1-Vol.3, pp 476-480) **Impact of air infiltration and ventilation on thermal comfort and health.** Nantka, M.B. (Silesin Technical Univ., Gliwice, Poland). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

This paper presents the results of a study on the indoor climate of 36 house characteristics of the Polish building industry. This work was carried out in two phases. The first phase included a questionnaire. Inquires were made in order to find out the habits of the occupants, especially relating to the thermal comfort and indoor air quality. In the second phase, the characteristic parameters for the thermal environment and ventilation were measured. The comparison of a large number of experiments on existing houses identifies the main directions of continued work for eliminating the excessive impact of air infiltration and ventilation on the indoor climate and energy consumption.

21881 (DOE/ER/60493—1-Vol.3, pp 481-486) **New Nordic standard proposal for measuring the thermal characteristics of clothing.** Olesen, B.W. (Technical Univ. of Denmark, Lyngby). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The main purpose of most clothing is insulation like we insulate our houses to avoid too much heat loss. In hot, cold or neutral environments the thermal characteristics of the clothing worn will have an important influence on the heat exchange between man and environment. A new Nordic standard describing how to measure thermal insulation, air permeability and water vapor permeability has recently been proposed. This standard mainly deals with the measurement of the thermal insulation (clo-value) using a thermal manikin. By this method the influence of textiles, design, fitness, opening etc. is taken into account. These methods are not only for cold-protective clothing, but may be used for all types of clothing. The intent of this standard is that clothing manufacturers in the future shall use the standard and mark their products with the thermal properties.

21882 (DOE/ER/60493—1-Vol.3, pp 487-490) **Subjective evaluation of thermal comfort and its relation to energy consumption for heating in dwellings.** Petras, D. (Slovak Technical Univ., Bratislava, Czechoslovakia). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The service of buildings is the second greatest consumer of energy in the energy-budget of our country. Heating, which represents about 80% of the energetic needs of the service of buildings, has a decisive position in it. A consequent installation of measuring and regulating devices enables to save energy in dwellings. On the other hand it has not decreased the quality of the thermal state indoors. These parameters have also been measured by subjective thermal sensations. In this paper, there are analyses of the users' thermal sensations when simultaneously reducing the energy consumption for heating of a specific flat.

21883 (DOE/ER/60493—1-Vol.3, pp 491-495) **Estimation of indoor thermal environment in office spaces.** Sagae, A.; Ohara, S.; Togari, S.; Nagatomo, M. (Kajima Institute of Construction Technology, Tokyo, Japan). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

This report proposes a method concerning the survey and analysis of indoor thermal environment in which the authors have introduced statistical methods and the multi-variate analysis into consolidated indoor environment surveys of office buildings, performed sensory evaluation by the occupants of the building, with respect to indoor thermal environment, and examined, through the use of the analysis of variance, etc., the relation among physical quantities such as the globe thermometer temperature, average SAT temperature and operational temperature.

21884 (DOE/ER/60493—1-Vol.3, pp 496-501) **Effects of air movement on thermal comfort during the summer season.** Tanabe, S.; Kimura, K.; Hara, T.; Akimoto, T. (Waseda Univ., Tokyo, Japan). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

During the summer 1986, 64 Japanese subjects wearing 0.5 clo standard clothing under sedentary activity were exposed to 4 different thermal conditions and 7 different air movements in a test chamber. Preferred air velocity and the relationship between air velocity and thermal sensation were investigated. It was found that preferred air velocity at modified air temperature of 27°C/50 %rh was 1.0 m/s, at 29°C/50 %rh 1.2 m/s, at 29°C/80 %rh 1.4 m/s and at 31°C/50 %rh 1.6 m/s. At low air velocity below 0.5 m/s present results of thermal sensation votes agreed well with those in our previous tests, but at higher air velocity above 0.5 m/s thermal sensation votes turned out much lower than those predicted by PMV and in our previous tests under low air velocity.

21885 (DOE/ER/60493—1-Vol.3, pp 501-506) **Design principles for thermally comfortable indoor spaces.** Yilmaz, Z. (Istanbul Technical Univ., Turkey). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

One of the most important functions of a built environment occupied by human beings is to provide thermally comfortable spaces for the users. Therefore, a great deal of artificial energy is consumed for heating or cooling indoor spaces to satisfy thermal requirements of users. In order to satisfy the users comfort and to reduce the energy consumption at the same time, building parameters affecting indoor climate should be determined properly during the design stage. The most important building parameters for an enclosure are the orientation, location and dimensions of the enclosure and physical properties of the envelope surrounding the enclosure. In this study, thermal effect of the building parameters on indoor climate was analyzed for a group of prefabricated buildings in Istanbul. The results of this analysis and recommendations for improving the design of these building from thermal comfort viewpoint are given in this paper.

21886 (DOE/ER/60493—1-Vol.3, pp 507-511) **Investigation of indoor thermal environment, air quality and energy consumption in highly insulated detached houses in Japan.** Yoshino, H.; Matsumoto, H.; Makita, K.; Hasegawa, F.; Utsumi, Y.; Akabayashi, S. (Tohoku Univ., Sendai, Japan). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Indoor thermal environment, air tightness, indoor air quality and energy consumption in thirteen newly constructed housing units in and around Sendai City were investigated in the winter of 1985. All houses have thermally insulated walls, ceilings and floors, except for one houses which does not have an insulated floor. Seven houses have concrete floors including hot water pipes and thermal insulation under the floor. The other houses have oil heaters or gas heaters. There were differences in temperature profiles between the houses with floor heating and those with space heaters. The concentrations of CO_2 and NO_2 in the living rooms of the two houses with unvented portable oil heaters were much higher than concentrations in the other houses. The total annual amount of energy consumed was distributed from 11 to 24 Gcal.

21887 (DOE/ER/60493—1-Vol.3, pp 526-532) **Tradeoffs between energy and indoor air quality considerations.** Berwager, S.D.; Rowan, S.S. (Bonneville Power Administration, Portland, OR). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The Northwest Power Planning and Conservation Act directed the Northwest Power Planning Council (Council) to develop Model Conservation Standards (MCS) for new buildings designed to produce energy savings that are both cost-effective to the regional power system and economically feasible for consumers. Implementing the MCS has proven to be a complex challenge for the Bonneville Power Administration (Bonneville) and the Pacific Northwest region of the United States. From the beginning, Bonneville has been faced with the need to deal with the tradeoffs between energy savings and indoor air quality. This paper will share Bonneville's experience from initial assumptions to revised analytical approaches and program designs based on an improved understanding of the relation among energy consumption, ventilation rates, and indoor air quality. This paper presents both technical and cultural risks of our experience.

21888 (DOE/ER/60493—1-Vol.3, pp 562-566) **Violations of building bylaws, energy conservation and bad maintenance as causes of indoor air pollution.** Ferahian, R.H. 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Bad Maintenance and violations of Building Bylaws and Standards - not only for HVAC systems - are major contributors to indoor air pollution. Examples are given. Consequences of the uncontrolled drive towards energy conservation in our buildings are discussed in light of both European and North American ventilation standards. Sometimes fans are switched off under the guise of energy conservation to coverup malfunctions in the HVAC system. Mandatory good maintenance of the building services essential for the health of the occupants is urgently needed as an essential part of our laws. Recommendations are made for designing building codes for better prevention of indoor air pollution. An Environmental Bill of Rights is advocated with the right of access to information necessary for citizens to determine the quality of their indoor environment and thus enable them to protect themselves.

21889 (DOE/ER/60493—1-Vol.4, pp 17-26) **What architects can do to improve indoor air quality.** Levin, H. (Univ. of California, Berkeley). 1987. NTIS, PC A 07. Order Number DE88004516/JAW. (CONF-870853—Vol.4).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The impact of architects' work on indoor air quality is significant. Very little has been done to guide architects towards improving indoor air quality in practice. Much indoor air quality research and applied work reported in the literature can be interpreted or translated into concrete actions available to architects to improve indoor air quality in the buildings they design. This paper examines the role of architects in the building process and presents practical, task-oriented suggestions for effective actions. It is presented to increase researchers' understanding of the building design process and the architect's role and also to increase architects' implementation of practices which can improve indoor air quality. Measures discussed include design, building construction, preoccupancy evaluation, operation, maintenance, and post-occupancy evaluation.

21890 (DOE/ER/60493—1-Vol.4, pp 27-48) **Air-conditioning new horizons - new opportunities.** Esdorn, H.; Knabl, H.; Kuelpmann, R. 1987. NTIS, PC A 07. Order Number DE88004516/JAW. (CONF-870853—Vol.4).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

In recent years the air conditioning industry has been confronted with many problems that have led to a noticeable drop in the economic development in some sectors, e.g. in office air conditioning. These problems were caused mainly by the drastic rise in energy prices in the early seventies which led to a critical attitude towards air conditioning on the part of those running buildings with air conditioning systems. However, these problems concerning energy consumption are basically solved nowadays because the pri-

mary energy usage has been reduced to about 35-50% of the usage at the beginning of the seventies due to the optimization of air conditioning systems.

21891 (DOE/ER/60493—1-Vol.4, pp 57-68) **Ventilation effectiveness - past and future.** Roedahl, E. (Norwegian Institute of Technology, Trondheim). 1987. NTIS, PC A 07. Order Number DE88004516/JAW. (CONF-870853—Vol.4).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

During the last decade methods for evaluating the ventilation processes are being developed. The studies have for one thing unveiled the advantages of displacement ventilation. In fact displacement ventilation is not a new invention, and the results are in accordance with qualitatively based statements made hundred years ago. People at that time came to the right conclusions mainly by observing that warmed air rises and cooled air sinks in the surrounding air. The development during the last decade represent an important step forward.

21892 (EPRI-EM—5452, pp 31.1-31.7, Section 31) **The intelligent house.** Juliussen, E. (Intellisys Corp., Dallas, TX (USA)). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920085/JAW. (CONF-870642—).

From 3. national conference on utility demand-side management programs: DSM strategies in transition; Houston, TX, USA (16 Jun 1987).

The use of computing power to control and advance the functionality of the existing subsystems in the home is a new, infant industry. The term "Home Automation" is commonly used to describe this emerging industry. This paper will review the status of home automation, explain why home automation products are needed, describe some examples of consumer benefits, outline how the products are likely to evolve, and comment on why it matters to demand-side management. 3 figs.

21893 **(EPRI-EM—5578-Vol.1) Energy use and conservation in the commercial sector: Volume 1, Conditional demand analysis applied to the Nonresidential Buildings Energy Consumption Survey (NBECS): Final report.** Parti, M.; Sebald, A.V.; Farber, M. (Applied Econometrics, Inc., Del Mar, CA (USA); Temple, Barker and Sloane, Inc., Lexington, MA (USA)). Feb 1988. 150p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920194/JAW.

This report describes an investigation into the application of an enhanced conditional demand analysis (CDA) technique to the estimation and forecasting of commercial sector energy demand. The report consists of two volumes. This volume, the first, presents the theoretical background of the procedure and applies it to a national data set. 4 figs., 24 tabs.

21894 **(EPRI-EM—5578-Vol.2) Energy use and conservation in the commercial sector: Volume 2, An application of the NBECS [Nonresidential Buildings Energy Consumption Survey] commercial conditional demand model to a test case utility, San Diego Gas and Electric Company: Final report.** Parti, M.; Sebald, A.V.; Farber, M. (Applied Econometrics, Inc., Del Mar, CA (USA); Temple, Barker and Sloane, Inc., Lexington, MA (USA)). Feb 1988. 106p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920193/JAW.

This report describes an investigation into the application of an enhanced conditional demand analysis (CDA) technique to the estimation and forecasting of commercial sector energy demand. The report consists of two volumes. This volume, the second, describes the application of the technique to a particular utility service area. 5 refs., 4 figs., 27 tabs.

21895 **(EPRI-EM—5610) EMPS-2.1 computer program for residential building energy analysis: Engineering manual: Final report.** Merriam, R.L.; Rancatore, R.J. (Little (Arthur D.), Inc., Cambridge, MA (USA)). Jan 1988. 115p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920186/JAW.

A comprehensive computer program, EMPS 2.1, has been developed for the analysis of residential building thermal loads, space conditioning and water heating energy use. The program consists of three modules: a building energy program; an economics analysis program; and an hourly weather tape processor. The energy analysis program is capable of multiple space analysis with central and/or unitary space conditioning systems including: furnace, one- or two-stage air-air heat pump, ground-coupled heat pump, room dehumidifier, and mechanical ventilation. Both time clock controlled and utility controlled (supervisory load managed) operation of the systems may be simulated. The electric water heating systems are conventional, time clock controlled, active solar, dedicated heat pump and heat recovery (desuperheat). The energy analysis program has been designed to be a highly flexible research tool. The economic analysis program provides a capability to evaluate time-of-day energy and demand rate schedules and to perform a simplified utility cost of service determination. TMY or SOLMET format data files may be used to prepare EMPS compatible weather tapes. 19 refs., 22 figs., 3 tabs.

21896 **(EUR—10292) Rational use of energy in health-care establishments, methods for determining possible energy savings.** (Commission of the European Communities, Luxembourg). 1986. 234p. (In French). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88752289/JAW.

Globally, the annual consumption of energy of health establishments in the EEC is some 7 to 8 million TEP, corresponding to an energy bill of 3.5 to 4 thousand million Ecus a year. On average, it is possible to reduce the consumption by some 20% thanks to a more carefully studied management of judicious investments. An important fact: in relation to other building sub-sections, the time factor in the return on investments is relatively low, in the region of two to three years. The Commission has estimated that it was necessary to make the technical management staff of hospitals aware of the problem and to bring to their attention the possible energy - and therefore financial - savings. For these reasons the Commission has drawn up a methodological guide for the research into energy savings in health establishments. This guide is made up of more than 200 technical sheets, grouped into eight subject areas, each sheet indicating: - the type of operation (description of improvement) - the probable energy gains - comments and finally - estimate of the profitability of the operation. This document is not destined to be substituted for thermic diagnosis: it constitutes a complement, allowing on the one hand an initial investigation and an initial evaluation of possible improvements, and on the other the conservation of energy saved thanks to good energy management. This must become a permanent preoccupation of hospital personnel.

21897 **(NYSERDA—87-21) Integrating analytical tactics into New York State's weatherization assistance program: Project findings, Final report.** (Synertech Systems Corp., Syracuse, NY (USA)). Sep 1987. 303p. NYSERDA, Two Rockfeller Plaza, Albany, NY 12223. Order Number TI88900445/JAW.

Four weatherization operations in Upstate New York employed blower doors and other analytical tools in the process of weatherizing approximately 100 dwellings. Two agencies employed their own crews; one used subcontractors to supply all labor; the fourth used a two-person crew to perform auditing and major air sealing work while subcontracting insulation work. An overall project savings of 22% was achieved, a number derived from data from elapsed time meters installed on clients' furnaces in conjunction with local weather information. Closure, as measured in improvement in air changes per hour at 50 Pascals, averaged 29%. One crew-based operation achieved 27% savings, the other 17. The subcontractor crews were at 20 and 21%. It is concluded that through very careful, analytical tool-aided analysis, sound decisions can be made concerning appropriate weatherization tactics to employ and resources to commit; a range of special tools and related strategies can be successfully integrated into the operations of local weatherization programs.

21898 **(NZERDC—149) Survey of household heating: Christchurch City: Final report.** Moody, T. (Automobile Association (Auckland), Inc. (New Zealand); Christchurch Health Dept. (New Zealand)). Sep 1987. 66p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88900401/JAW.

This report summarizes the findings of a survey of home heating undertaken in Christchurch City and relates to energy use in 1981. The results are based on a sample of 6934 households spread through the 48 cenus sub-diviions of the city and represents approximately an 11% sample of total households present at that time. It reports patterns of household heating, solid fuel, electricity, and oil used for home heating and estimated costs of such energy sources. Reasons for choices of heating methods and proposed future methods are reported. Awareness, and perceived sources and effects, of air pollution in Christchurch are examined. Substantive characteristics of dwelling types and household characteristics associated with differing energy uses are reported. Comparisons with similar surveys in 1972 and 1978 are made.

21899 **(ORNL/CON—245) Impact of CFC [chlorofluorocarbon] restrictions of US building foundation thermal performance.** Christian, J. (Oak Ridge National Lab., TN (USA)). Dec 1987. Contract AC05-84OR21400. 72p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88006143/JAW.

A significant increase in the use of foundation insulation had been expected as a result of the near completion of ASHRAE 90.2P, New Building Energy Efficiency Standard, and the publication of several Department of Energy foundation design tools. Potential restrictions on the future availability and/or price of chlorofluorocarbon (CFC)-12 will have a potentially substantial impact on the goal of improving the efficiency of building foundations. One of the better ways to insulate foundations is on the exterior in contact with the earth, and one of the better insulating products for this application is extruded polystyrene (XEPS). According to some personnel in the Environmental Protection Agency, it is likely that because XEPS is currently blown with CFC-12 and since CFCs could be a major contributor to anticipated future ozone depletion, some restrictions are imminent. The work statement for this analysis called for an initial impact analysis on energy conservation goals and a foundation research plan to mitigate the impacts of restricting the use of CFCs in foundation insulation systems. This report addresses quantitatively the energy-saving impacts at the state level of CFC restrictions on foundation insulation and concludes that the total impact could be anywhere from near zero to 0.8 quad in the year 2010, with the most likely impact being about 0.13 quad/year. The risk of high impacts can be reduced by an accelerated research effort focused on developing and demonstrating insulated foundation systems that have overall performance equivalent or superior to that of exterior XEPS insulated basement walls, crawl space walls and slab-on-grade systems. 27 refs., 14 figs., 19 tabs.

21900 **(PB—88-138268/XAB) Calculation of the illuminance factor from translucent rooflights illuminated by sunlight.** Boyd, I.H. (Council for Scientific and Industrial Research, Pretoria (South Africa). National Building Research Inst.). Nov 1985. 15p. (R/BOU—1337). NTIS, PC E04/MF E04.

North American Continent sales only.

The estimation of energy savings by the use of daylight requires an accurate calculation of the illuminance it can provide indoors. This paper describes a computer procedure for the calculation of the illuminance factor from sunlit, translucent windows such as those used in factory rooflights. The method takes into account the diffusing power of the glazing material, the light reflected from the outdoor surroundings, and the light reflected internally. The procedure is evaluated by comparing calculated values with those measured in scale models.

21901 **(PB—88-157391/XAB) Open-cycle centrifugal vapor-compression heat pump. Final report, January 1986-May 1987.** Burgmeier, L.R.; Horner, J.E. (Allied-Signal Aerospace Co., Torrance, CA (USA). AiResearch Los Angeles Div.). 30 Nov 1987. 33p. (DOC—87-60964). NTIS, PC A03/MF A01.

See also PB—86-103884.

The objectives of the program were (1) to develop an open-cycle, high-lift, centrifugal steam-compressor system that can be efficiently retrofitted to existing multi-effect and high-temperature differential evaporators while maintaining the cost benefits of a single-stage centrifugal compressor, and (2) to demonstrate the energy saving and cost benefits of driving the compressor with a natural-gas-fueled gas-turbine engine. The turbine exhaust was to be used for final drying of the product that was evaporated. The report describes the installation of the system and the test activities through May 1987.

21902 **(PB—88-160874/XAB) High-speed volumetric trochoidal gas compressor for use as a heat pump. Final report, January 1981-July 1986.** (Trochoid Power Corp., Eden Prairie, MN (USA)). Sep 1986. 126p. NTIS, PC A07/MF A01.

Contract covered design, development and manufacture of a 300-cfm volumetric compressor based on trochoidal geometry. The device is capable of maintaining given pressure ratios over a wide range of speeds, because of its positive-displacement nature. Lacking reciprocating parts, it is dynamically balanced and unusually quiet in operation. As its primary mission was to compress steam, compression ratios of 6:1 were not sought.

21903 **(PB—88-856083/XAB) Energy conservation through building design. October 1984-December 1987 (citations from the NTIS data base). Report for October 1984-December 1987.** (National Technical Information Service, Springfield, VA (USA)). Jan 1988. 70p. NTIS PC N01/MF N01.

Supersedes PB—86-875747.

This bibliography contains citations concerning methods and equipment utilized in the design of residential and commercial buildings to decrease energy consumption. Topics include energy conservation program descriptions and the utilization of alternative energy sources and building designs in retrofitting existing buildings and new construction. Methods of calculating and computing envelope thermal loads and payback periods are presented. (This updated bibliography contains 132 citations, 20 of which are new entries to the previous edition.)

21904 **(PNL—6454) Residential and commercial buildings data book: Third edition.** Amols, G.R.; Howard, K.B.; Nicholls, A.K.; Guerra, T.D. (Pacific Northwest Lab., Richland, WA (USA)). Feb 1988. 203p. NTIS, PC A10/MF A01. Order Number TI88006440/JAW.

This Data Book updates and expands the previous Data Book originally published by the Department of Energy in September, 1986 (DOE/RL/01830/16). Energy-related information is provided under the following headings: Characteristics of Residential Buildings in the US; Characteristics of New Single Family Construction in the US; Characteristics of New Multi-Family Construction in the US; Household Appliances; Residential Sector Energy Consumption, Prices, and Expenditures; Characteristics of US Commercial Buildings; Commercial Buildings Energy Consumption, Prices, and Expenditures; and Additional Buildings and Community Systems Information. 12 refs., 59 figs., 118 tabs.

21905 **(PNL—6478) HVAC [heating, ventilation, air conditioning] literature in Japan: A critical review.** Hane, G.J. (Pacific Northwest Lab., Richland, WA (USA)). Feb 1988. Contract AC06-76RL01830. 141p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88006146/JAW.

Japanese businessmen in the heating, ventilation, air conditioning, and refrigeration (HVAC&R) industry consider the monitoring of technical and market developments in the United States to be a normal part of their business. In contrast, efforts by US businessmen to monitor Japanese HVAC & R developments are poorly developed. To begin to redress this imbalance, this report establishes the groundwork for a more effective system for use in monitoring Japanese HVAC & R literature. Discussions of a review of the principal HVAC & R publications in Japan and descriptions of the type of information contained in each of those publications are included in this report. Since the Japanese HVAC & R literature is

abundant, this report also provides practical suggestions on how a researcher or research manager can limit the monitoring effort to the publications and type of information that would most likely be of greatest value.

21906 **(SERI/SP—271-3248) Research and testing facilities for solar buildings technology.** (Solar Energy Research Inst., Golden, CO (USA)). Dec 1987. Contract AC02-83CH10093. 21p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001106/JAW.

In keeping with the national energy policy goal of fostering an adequate supply of energy at a resonable cost, the US Department of Energy (DOE) supports a variety of programs to promote a balanced and mixed energy resource system. The mission of the DOE Solar Buildings Technology Program is to support this goal by providing for the development of solar technology alternatives for the buildings sector. It is the program's goal to establish a proven technology base to allow industry to develop solar products and designs for buildings that are economically competitive and can contribute significantly to building energy supplies nationally. Toward this end, the program sponsors research activities related to increasing the efficiency, reducing the cost, and improving the long-term durability of passive and active solar systems for building water and space heating, cooling, and daylighting applications. These activities are conducted in four major areas: Advanced Passive Solar Materials Research, Collector Technology Research, Cooling Systems Research, and Systems Analysis and Applications Research. This booklet describes facilities, equipment, and other resources available at university and federal laboratories participating in the Solar Buildings Technology Program. The purpose of the booklet is to inform scientists, engineers, and other researchers in the buildings industry and in universities about these resources that are available for both cooperative and independent research.

3202 Transportation

REFER ALSO TO CITATION(S) 21925

21907 **(CONF-8710188—2) Micro- and macroeconomic responses to energy price shocks: A discussion of past, present, and future economic problems in simultaneously introducing alternative fuels and major efficiency-enhancing vehicular engine innovations.** Santini, D.J. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 75p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88005943/JAW.

From Joint national meeting of the Operating Research Society of America and the Institute of Management Sciences; St. Louis, MO, USA (25 Oct 1987).

This paper provides both general and particular views of the process and macroeconomic side effects of frequent energy cost shocks and introduction of alternative transportation fuels and vehicular engines in response to severe pairs of such shocks. The value of "energy-squeeze" hypotheses, the dispersio hypothesis, and "double bump" innovation hypotheses as explanations of energy/macroeconomy interactions are discussed. The history of major US transportation fuel and mode switches are reviewed. The role of fuel scarcity in promoting vehicular engine innovation and of the innovative engines in then making each of the fuel and/or mode switches economically desirable is discussed. The causes of macroeconomic difficulties during the transition from mode-to-mode, fuel-to-fuel, and/or engine-to-engine are examined. The long historical pattern of fuel, mode, and engine substitution is reviewed to develop an understanding of the probable characteristics of the next fuel switch. It is argued that the next mass-marketed transportation fuel will be derived from natural gas, namely methanol.

21908 **(NYSERDA—87-23) Development and demonstration of marketing techniques for establishment of ridesharing corporations in New York State: Final report.** Peters, E.W.; Matthews, N.P. (ed.). (Island Rides, Inc., Melville, NY (USA)). Oct 1987. 111p. New York State Energy Research and Development Authority, Two Rockefeller Plaza, Albany, NY 12223. Order Number TI88900455/JAW.

The intent of this project was to develop, demonstrate and evaluate marketing techniques for the establishment of ridesharing corporations in New York State. The objectives of the first phase of the project were to: (1) develop a "how-to" guide for establishing a ridesharing corporation; and (2) conduct a market assessment to identify specific methods for capturing potential users of the service. The objectives of the second phase of the project were to: (1) prepare and implement a marketing strategy to address the various major users and evaluate the viability of new marketing techniques developed in Phase 1 and marketing techniques developed during the first year of operations; and (2) develop and disseminate a "how-to" guide regarding the development, implementation and evaluation of marketing strategies for ridesharing in New York State.

21909 **(NZERDC—146) Fleetsave Fleet Management Programme and data monitoring: Automobile Association (Auckland) Inc., Beca Carter Hollings and Ferner Ltd. and ministry of Energy Joint Programme, Parts 1 and 2.** (Automobile Association (Auckland), Inc. (New Zealand); Beca, Carter, Hollings and Ferner Ltd., Auckland (New Zealand)). Aug 1987. 53p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88900403/JAW.

The Ministry of Energy and the Automobile Association (Auckland) Inc. jointly agreed in 1981 to introduce a fleet management program (Fleetsave) aimed at reducing fuel consumption in light vehicle fleets. Two GasCap personnel were brought to New Zealand to demonstrate their program held at AA Auckland's premises during February 1982. It was agreed that the concept of GasCap was based on sound, sensible and proven techniques that had been used by the AA in part for several years. In essence, GasCap brought all these ideas together, and the expanded the format by including techniques for obtaining client commitment, fleet management, and program expansion. During December 1982, NZERDC awarded Contract 3297. The purpose of the contract was to ascertain how clients received the program and whether it had sufficient promise to warrant development to commercialization. The report presents the experience of those involved in that Contract: the AA (Auckland), MOE, and Beca Carter Hollings and Ferner.

21910 **(PB—88-133111/XAB) Transit productivity program: going on the offensive in productivity-management studies and performance monitoring. Session 2. 1983 APTA (American Public Transit Association) annual meeting, Denver, Colorado.** Maloney, J.; Kiepper, A.F.; Simonetta, R.J. (American Public Transit Association, Washington, DC). Oct 1983. 87p. NTIS, PC A05/MF A01.

See also Session 1, PB—88-133129, and Session 3, PB—88-133103.

The volume examines monitoring and reporting procedures applicable to performance and productivity. The managers of three transit systems of varying sizes discuss how productivity has been increased within their systems. The Pittsburgh discussion reviews a variety of capital projects and management improvement initiatives undertaken by Port Authority Transit, including development of maintenance manuals and an absenteeism reduction project. The Houston discussion describes how the property used a management study to identify needed organizational change and restructuring. The Ann Arbor discussion focuses on a set of service standards and performance indicators adopted to focus the management improvement process.

21911 **(PB—88-141783/XAB) Traffic mitigation and demand management: summary of national experience and potential applications in New York.** Oram, R.L. (Transit Innovations and Program Development, New York (USA)). Jul 1987. 31p. NTIS, PC A03/MF A01.

This report reviews actions taken in North American cities in the past 10 years to reduce traffic congestion by managing transportation demand rather than expanding the supply of highways or transit services. Some of the actions have been implemented only in suburban areas, while many are now in use in the business districts of San Francisco, Los Angeles, Seattle and other major cities. Application of these actions to the unique characteristics of Manhattan and New York City is considered. The three major components of a traffic-mitigation strategy are parking management, employer promotion of transit use, and developer and employer incentives and

ordinances. The initiatives with the most promise appear to be alternative work hours programs, policies to reduce long-term parking downtown, preferential parking at line haul transportation facilities, expanded employer promotion of transit, brokerage and transportation management associations, and employer traffic reduction ordinances.

21912 **(PB—88-143334/XAB) Small transit vehicles: how to buy, operate, and maintain them. Final report.** Boghani, A.B.; Palmer, D.W.; Gott, P.G.; Nayak, P.R. (Little (Arthur D.), Inc., Cambridge, MA (USA)). Jan 1985. 59p. NTIS, PC A04/MF A01.

Report on National Cooperative Transit Research and Development Program. Library of Congress catalog card No. 85-50008.

Maintenance and operating-cost data for small buses are provided in this report. These data were obtained by analyzing the maintenance and fuel use records of 187 small buses from 16 transit properties located in different parts of the country. Specific cost data are provided for four types of small bus: vans and modified vans, body on van chassis, body on truck chassis, and purpose-built. Both the labor hours required for maintenance and operation are provided on a per mile basis. The effects of climate and duty cycle on total maintenance cost are determined. Several qualitative aspects of small-bus selection are also analyzed. These include the performance characteristics of the buses, their reliability, available options, and planning for maintenance.

21913 **(PB—88-143342/XAB) Strategies to implement benefit-sharing for fixed-transit facilities. Final report.** Howard, J.A.; Rivkin, G.; Brecher, S.; Heder, L. (S.G. Associates, Annandale, VA (USA)). Jul 1985. 223p. NTIS, PC A10/MF A01.

Library of Congress catalog card No. 85-50733.

The concept of sharing the benefits of construction, operation, renovation, or reuse of fixed-transit facilities with land development is explored. Also explored is whether strategies geared to benefit-sharing can become a basis for transit finance. The researchers have sought to identify the types of transit facilities that may offer opportunities for benefit-sharing, the types of benefits that might be shared, and various ways transit agencies of various sizes can pursue benefit-sharing.

3203 Industry And Agriculture

REFER ALSO TO CITATION(S) 21227, 21365, 21706, 21721, 21722, 21730, 21933, 22346

21914 **(AD-A—187377/7/XAB) Process design model for a single-zone tunnel dryer. Master's thesis.** Flake, B.A. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA)). Dec 1987. 169p. (AFIT/CI/NR—87-79T). NTIS, PC A08/MF A01.

Many products must be dried in their manufacture. The process of evaporating moisture from these products is energy intensive. As a consequence of limited energy resources, there has been advancement in both drying technology and drying theory. However, drying has evolved from an ancient art and implementation of new technology has been slow. Dielectric heating at radio frequencies (RF) or microwave frequencies is a relatively recent technological advancement in the drying industry, and theoretical and experimental studies of dielectrically-assisted drying are the subject of ongoing investigation. Transfer of this new knowledge to dryer designers through appropriate design tools will accelerate the incorporation of dielectric heating into commercial drying processes. Directed toward a larger goal of predictive design models of dielectrically-assisted dryers, the objective of this work is to develop a fundamental model of the drying processes in a continuous convective tunnel dryer. A model of the drying process consists of two subsidiary models. One represents the transport of the product through the dryer, an equipment model, and the other describes the drying kinetics of the product. For conventional convective drying, the product model may be represented by a characteristic drying curve which allows prediction of drying rates under various external convective conditions.

21915 **(AECC—86-JAA-001-F) Innovative, counterflow gas/fine solids, direct contact heat exchanger: Final report.** Mah, C.S. (Aerojet Energy Conversion Co., Sacramento, CA (USA)). Oct 1987. Contract AC01-85CE90232. 125p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88004744/JAW.

The Aerojet Energy Conversion Company has completed the first phase of study for development of a heat exchanger. The heat exchanger, a highly efficient, low cost concept, is a candidate for application in process manufacturing industries such as cement, lime, or glass. The analytical effort was to establish the heat exchanger performance via computer modeling and analysis; the experimental effort was to demonstrate the heat exchanger performance.

21916 **(AFME—84-0586) Recovery and supply model for an acetone - butanol - ethanol production facility. Application to the Centre region.** Requillart, V. (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). Mar 1985. 57p. (In French). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88752267/JAW.

A linear programming model is developed for the optimization of the localization and the size of a plant producing acetone, ethanol and butanol from lignocellulosic agricultural wastes. The modelling parameters are the agricultural by-products disponibilities, the humid factor, the various by-products supply possibilities and the waste transport and storage factors. The model has been tested on the center region of France.

21917 **(DOE/CE/40637—T2) Fundamental studies of black liquor combustion: Report No. 2, Phase 1 (October 1984-November 1986).** Clay, D.T.; Lien, S.J.; Grace, T.M.; Macek, A.; Semerjian, H.G.; Amin, N.; Charagundla, S.R. (Institute of Paper Chemistry, Appleton, WI (USA). Chemical Sciences Div.; National Bureau of Standards, Washington, DC (USA). Chemical Process Metrology Div.). Jan 1987. Contract AC02-83CE40637. 240p. NTIS, PC A11/MF A01; 1; GPO Dep. Order Number DE88005756/JAW.

The fundamentals of kraft black liquor combustion are being studied in a five year project. This report covers the second and third years of work by The Institute of Paper Chemistry (IPC) and the National Bureau of Standards (NBS) for the US Department of Energy. The burning processes are being studied in two continuous flow reactor systems designed to both study overall process and single particle phenomena. Black liquor burning is divided into four distinct phases: drying, volatiles burning, char burning, and smelt coalescence. Phase 1, In-flight Processes, is the main focus of this report. In-flight processes include mainly the stages of drying and volatiles burning. Testing results in both flow reactors and in two specially designed single particle reactors are presented. Dynamic droplet velocity and swelling have been measured for the first time. A direct link between initial liquor viscosity and burning behavior in the early stages has also been identified. During the fourth year Phase 1 will be completed and Phases 2 (Char Burning) and 3 (Fume Processes) will begin.

21918 **(DOE/ID/12553—1) Separation, fractionation, concentration and drying of food products: Technology progress report, October 1, 1984-March 3, 1987.** Rose, W.W.; Pederson, L.D.; Merlo, C.A.; Brewbaker, P.L. (National Food Processors Association, Dublin, CA (USA)). Nov 1987. Contract AC07-84ID12553. 119p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88006269/JAW.

This report describes the first and second phases of a three phase project, the object of which is to develop energy efficient separation, concentration, and drying processes for food products, especially juice products, in order to reduce energy requirements and their associated costs for processing, preservation, and transportation. Presently in juice processing, much water is eliminated through evaporation. However, there are significant limits to the current evaporation technology. If, however, the juice could be separated, prior to evaporation, into liquid and solid fractions, and the liquid concentrated further, the containerization and transportation costs could be significantly reduced. Separation methods inves-

tigated in this project are: vacuum filtration, centrifugation, and crossflow microfiltration.

21919 **(DOE/ID/12655—1) Cerium oxide coated anodes for aluminum electrowinning: Topical report, October 1, 1986-June 30, 1987.** Walker, J.K. (ELTECH Research Corp., Fairport Harbor, OH (USA)). Dec 1987. Contract AC07-86ID12655. 151p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE88006572/JAW.

Because of the cost of building and maintaining a carbon anode plant and the energy penalties associated with the use of carbon anodes in the production of aluminum, the use of inert anodes has long been proposed. Various cermet anodes have been investigated. In this paper, tests on a material, cerium oxyfluoride (CEROX), deposited in situ as an anode, are reported. (JDH)

21920 **(ENEA-RT-TIB—87-14) Laser and electronic beam: comparison between two welding techniques.** Dalmastri, B. (ENEA, Rome (Italy)). Jul 1987. 70p. (In Italian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88751898/JAW.

EB and Laser welding have been successfully applied in the industrial field and their increased use is being forecasted for the future. The two techniques, both characterized by a high energy density, differ, however, in origin, nature, behaviour and performance. It is useful, for this reason, especially for future potential users, to have a review of present, state-of-the-art application.

21921 **(EPRI-EM—5633-Vol.1) DSM [demand-side management] commercial customer acceptance: Volume 1, Program planning insights: Final report.** George, S.S.; Kirksey, W.E.; Skelton, J.C. (XENERGY, Inc., Oakland, CA (USA); Battelle Columbus Div., OH (USA)). Jan 1988. 126p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920187/JAW.

To aid utilities in developing effective demand-side management (DSM) programs, the Electric Power Research Institute has undertaken a project (RP2548) to improve and integrate pertinent tools, methods, and data for application to DSM. The research covered by this project included the present investigation into the factors that determine the commercial customer acceptance of DSM programs. Utilities use an extremely diverse set of program options and features to influence customer energy consumption and demand. However, the number of commercial sector DSM programs is still too limited and the characteristics too diverse to allow the development of rigorous, empirical conclusions from existing data regarding the impact of various factors on customer participation. Nevertheless, through the review of market research studies and a survey of over one hundred utility DSM program managers, it was possible to identify several primary factors that significantly influence customer acceptance of DSM programs in the commercial sector. Among these key factors are: understanding and meeting customer needs; customer characteristics; effective communication; internal utility promotion and program management; and external influences. The relative importance of these factors varies among general program categories. For all programs, however, the study concludes that the most important factor affecting program participation is understanding and meeting customer needs. Included among the needs and motivations discussed at length in the report are economics, financing, risk aversion, time management, and comfort. The report uses the insights gained regarding these imprtant influencing factors to evelop guidance for planning more effective DSM programs. 34 refs., 14 figs., 22 tabs.

21922 **(ORNL—6298) Energy requirements of development projects.** Jones, D.W.; Samuels, G. Jr. (Oak Ridge National Lab., TN (USA)). Jan 1988. Contract AC05-84OR21400. 33p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005800/JAW.

This report focuses on the energy requirements of pumped irrigation and cement plants as examples of the energy operating requirements of large development projects. Based on conservative assumptions about the nearness of the water table to the surface and the efficiency of operating pumping systems, using pumped irrigation to increase by 5% the arable land area of the countries studied would require energy equivalent to 4-1/2% to 8-1/2% of 1980 energy imports or commercial energy consumption of four of the countries; Somalia and Chad would require 15% and 22% of their 1980 oil import or consumption levels - partly because of relatively large, marginally arable land areas and partly because of low energy imports (commercial consumption). The introduction of one or (at most) two moderate-sized cement plants into five West African countries and Sudan requires from 12% to 40% of those countries' 1980 national commercial energy consumption for their operation. These calculations assume high levels of maintenance and developed country standards of fuel efficient operation; therefore actual fuel requirements are likely to be higher. The countries studied have few or no domestic fuel supply options other than imports. 2 figs., 2 tabs.

21923 **(PB—88-129028/XAB) Techno-economic comparison of air and steam drying.** Faber, E.F.; Heydenrych, M.D.; Hicks, R.E. (Council for Scientific and Industrial Research, Pretoria (South Africa). Chemical Engineering Research Group). 1984. 15p. NTIS, PC E04/MF E04.

North American Continent sales only.

Drying in superheated steam has been advocated as a means of reducing the energy wastage that occurs with conventional air drying. A procedure for choosing between the two drying media on an economic basis is presented. Design data obtained with a novel test system confirm the existence of an inversion temperature above which drying in steam occurs faster than in air. The capital costs of a steam-drying system have been found to be the same as those of an air-drying system. The running costs of a steam-drying system are, however 45% lower than those of an air-drying system.

21924 **(PB—88-133012/XAB) Domestic secondary lead industry: production and regulatory compliance costs. Information circular/1987.** Smith, R.C.; Daley, M.R. (Bureau of Mines, Denver, CO (USA). Intermountain Field Operation Center). 1987. 24p. (BM-IC—9156). NTIS, PC A03/MF A01.

Also available from Supt. of Docs.; Library of Congress catalog card No. 87-600137.

The Bureau of Mines conducted a study of production costs for the secondary lead industry and determined costs for present, pending, and proposed environmental legislation. Operating costs for smelters by capacity groups range from 16.8 cents to 19.6 cents/lb of refined lead. Present regulatory compliance costs for these groups range from 2.2 cents to 2.4 cents/lb. Pending compliance costs can add 3.5 cents/lb of refined lead, and proposed regulations could add another 1.3 cents/lb. The individual capital costs necessary to comply with pending environmental regulations are estimated to be $1.8 million for small smelters and $10.4 million for large smelters. Proposed regulations could require additional expenditures from $1.9 million for small smelters to $4.9 million for large smelters.

21925 **(PB—88-135926/XAB) Potential for energy savings in pavement rehabilitation.** Servas, V.P.; Walker, R.N. (Council for Scientific and Industrial Research, Pretoria (South Africa). National Inst. for Transport and Road Research). 1986. 20p. (CSIR-RR—442). NTIS, PC E04/MF E04.

Summary in Afrikaans. Also pub. in Proceedings of the Annual Transportation Convention (ATC 1986), Pretoria, Vol. 1C paper 1C/1 August 1986; North American Continent sales only.

Since the 1973 oil crisis, many organizations and government departments have examined the energy requirements associated with roads and transport in order to identify possible ways to conserve energy. The paper shows that, although the energy used in processing, haulage, and construction is important, the competitive market system will tend to ensure that energy use is minimized. It further shows that the energy cost of using new or recycled materials is one of many factors to be taken into account in the decision to recycle pavement materials and that its importance, therefore, should not be over-emphasized.

21926 **(PB—88-139589/XAB) Industrial electric motors and controllers. Final report.** (Worley Consultants Ltd., Auckland (New Zealand)). Jun 1987. 154p. NTIS, PC E07/MF A01.

This report sets out to determine the scope for energy savings to be made through the more-efficient use of the electrical energy consumed by 400-volt, 3-phase asynchronous induction motors within New Zealand industry. The report examines the energy performances of standard and high-efficiency motors together with the ranges of solid-state controllers, and the part they can play in achieving savings. The report concludes that there is considerable scope for energy savings to be made, and that the measures that may be taken to achieve these savings are economically viable. Finally, recommendations are made for implementation of an energy-conservation program targeted at industrial-motor users.

21927 **Acoustic resonance in heat exchanger tube bundles - Part II: Prediction and suppression of resonance.** Blevins, R.D.; Bressler, M.M. (Rohr Industries, San Diego, CA 92012). *Journal of Pressure Vessel Technology;* **109**: No. 3, 282-288(Aug 1987).

In the first part of this series, experimental data were presented which suggest that the acoustic resonance in heat exchanger tube bundles is tied to periodic vortex shedding from the tubes. In this paper, a semi-empirical model for predicting the onset of resonance is developed. This model is compared with experimental data and other models from the literature. Methods of suppressing the resonance are developed and experimental data on their effectiveness are presented.

21928 **Acoustic resonance in heat exchanger tube bundles - Part I: Physical nature of the phenomenon.** Blevins, R.D.; Bressler, M.M. (Rohr Industries, San Diego, CA 92012). *Journal of Pressure Vessel Technology;* **109**: No. 3, 275-281(Aug 1987).

The intense acoustic resonance resulting from gas flow across a bank of heat exchanger tubes in a duct has been investigated experimentally and theoretically. At low gas velocities, the acoustic tone emanating from tube bundles increases in proportion to the flow velocity. When the frequency approaches a bound acoustic transverse mode of the tube bundle, intense sound can result. Sound levels as high as 173 db were measured within the bundle. During resonance, the sound correlates vortex shedding from the tubes and the pressure drop increases in some bundles.

3206 Municipalities And Community Systems

REFER ALSO TO CITATION(S) 21153, 21194, 21213, 21721, 21722, 21807

21929 **(DOE/CE/26552—T2) District heating and cooling for the city and port of Tacoma: Phase 1, Feasibility study.** Bloomquist, R.G.; Simpson, S.J. (Washington State Energy Office, Olympia (USA)). 5 Jan 1988. Contract FG01-86CE26552. 307p. (WAOENG—88-02). NTIS, PC A14. Order Number DE88004806/JAW.

Expansion and up grade of Tacoma's largest sewage treatment facility together with a proposed biomass cogeneration plant sparked the interest of Washington State Energy Office (WSEO) to look at the district heating and cooling (DHC) potential. Sewage effluent is used in several Swedish cities as a heat source in heat pump assisted district heating systems. The treament facility is located adjacent to downtown and the new effluent transfer pipline will run through the port district in route to the Commencement Bay. Other potential heat sources are the proposed biomass cogeneration plant and Simpson Tacoma Kraft Pulp and Paper Mill. The pulp mill is also adjacent to downtown, however, the proposed cogeneration plant will be about a mile away. A preliminary district heating analysis was performed using a computer analysis tool called HEATPLAN. The analysis was favorable and a decision to move ahead with further study was made by WSEO.

21930 **(DOE/CE/26563—5) Open-cycle heat pump development for local resource use: Final report, July 18, 1986-October 18, 1987.** Becker, F.E.; Balsavich, J.C.; Zakak, A.I. (TECOGEN, Inc., Waltham, MA (USA)). 30 Nov 1987. Contract FG01-86CE26563. 169p. (TE—4402-181-87). NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE88003228/JAW.

A district heating system that uses low-level waste energy sources and a quasi open-cycle heat pump as a means of upgrading this energy in the form of hot water has been examined. The use of a steam/water based open-cycle heat pump appears to be well suited for use with higher temperature waste-heat sources, such as those found in industrial waste streams. Since this heat pump concept uses the steam/water system, it does not require the more commonly used chlorinated fluorocarbons, which are environmentally harmful and expensive. Under this work, a case study was performed using the heat pump to extract waste heat from a chemical plant and using it to heat a large-sized commercial operation. As a result of this case study, it was found that by using readily available components, a system could be constructed to provide over 2.8 MMBtu/h of heat to the facility, and have an actual system payback of 4.8 years.

21931 **(EPRI-EM—5587-Vol.1) Implicit discount rates in residential customer choices: Volume 1, Investments in conservation measures: Final report.** Goett, A.A. (Cambridge Systematics, Inc., Berkeley, CA (USA)). Feb 1988. 102p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920210/JAW.

Discount rates have been used in a number of energy forecasting models and demand-side analyses as key parameters to predict the adoption rates of energy technologies and their efficiency characteristics. In these applications, there has been considerable controversy both about the concept of discount rates and about what empirical values most accurately represent actual consumer behavior. Given the importance of implicit discount rates in some forecasting models and their widespread use in analysis of the market potential of energy-related durables, EPRI RP-2547 was designed to estimate the magnitude of discount rates for various equipment choices and to evaluate their usefulness as a forecasting parameter. This report summarizes the results of two studies of the discount rates implicit in household decisions to install conservation measures and purchase high efficiency appliances. The first study addressed conservation actions by households using data collected in conjunction with conservation audit programs. This is summarized in this volume of the report.

21932 **(EPRI-EM—5587-Vol.2) Implicit discount rates in residential customer choices: Volume 2, Investments in efficient appliances: Final report.** (Cambridge Systematics, Inc., Berkeley, CA (USA)). Feb 1988. 52p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920211/JAW.

Discount rates have been used in a number of energy forecasting models and demand-side analyses as key parameters to predict the adoption rates of energy technologies and their efficiency characteristics. In these applications, there has been considerable controversy both about the concept of discount rates and about what empirical values most accurately represent actual consumer behavior. Given the importance of implicit discount rates in some forecasting models and their widespread use in analysis of the market potential of energy-related durables, EPRI RP-2547 was designed to estimate the magnitude of discount rates for various equipment choices and to evaluate their usefulness as a forecasting parameter. This report summarizes the results of two studies of the discount rates implicit in household decisions to install conservation measures and purchase high efficiency appliances. The second study addressed appliance efficiency choices using data from a high efficiency appliance rebate program. This is summarized in this volume of the report.

21933 **(PB—88-857586/XAB) Sludge dewatering: sewage and industrial wastes. January 1978-January 1988 (citations from Pollution Abstracts). Report for January 1978-January 1988.** (National Technical Information Service, Springfield, VA (USA)). Feb 1988. 81p. NTIS PC N01/MF N01.

Supersedes PB—85-860732.

This bibliography contains citations concerning techniques and equipment used in sewage, and industrial, mining, petroleum and municipal waste-sludge dewatering. Dewatering processes, device design, and performance evaluations are considered. (This updated bibliography contains 233 citations, 51 of which are new entries to the previous edition.)

3209 Education And Public Relations

REFER ALSO TO CITATION(S) 21714, 21908

33 ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

REFER ALSO TO CITATION(S) 21907

3301 Internal Combustion Engines

REFER ALSO TO CITATION(S) 21208, 21944, 21945, 22802

21934 **(ORNL/Sub—85-28609/1) Engine testing for synfuel operation.** Dickey, D.W.; Vinyard, S.; Callahan, T.J.; Ryan, T.W. III; Warner-Selph, M.A.; Sefer, N.R. (Southwest Research Inst., San Antonio, TX (USA)). Jan 1988. 336p. NTIS, PC A15/MF A01. Order Number DE88006044/JAW.

A heavy duty diesel engine was tested for operation on minimally processed synthetic fuels. Fuels included in this test were a reference No. 2 diesel fuel and liquid products derived from shale, tar sands, and coal. Performance, gaseous and particulate emissions, cold startability and deposit formation with extended idle were tested. Phase I includes baseline testing of a state-of-the-art heavy duty diesel engine meeting current Federal emissions standards. Phase II includes determining practical engine modifications to enhance synfuel operation and a repeat of selected Phase I tests. This report is the result of Phases I and II. 6 refs., 53 figs., 7 tabs.

21935 **(PB—88-144118/XAB) Reliable gasoline-engine knock-detection system.** Ekchian, L.K. (OPTIMA Systems, Inc., Burlington, MA (USA)). Aug 1985. 103p. NTIS, PC A06/MF A01.

The purpose of the research was the development of a reliable system for real-time detection of the presence of engine knock and estimation of its severity. The KDE (Knock Detection/Estimation) System was successfully developed and tested with real engine data. The results were extremely promising and clearly demonstrated its superiority over current knock detection. The most viable means for sensing knock at present is by monitoring engine vibration. However, two crucial problems which all production systems have not as yet been able to deal with are: (1) the effect of knock on the vibration signal can be masked to a great degree by other spurious vibration sources, e.g., piston slap, valves, gear train, etc., and (2) the dynamics and occurrence of knock are highly stochastic in nature. The KDE is shown to be highly reliable and not to suffer from these two problems.

21936 **(PB—88-147863/XAB) Practical system for the use of alcohol in diesel engines. Final report.** Savage, L.D.; White, R.A. (Illinois Univ., Urbana (USA). Dept. of Mechanical and Industrial Engineering). Nov 1987. 311p. NTIS, PC A14/MF A01.

This study investigated the fumigation of ethanol and methanol into diesel engines with the aim of developing a simple and practical microchip-controlled alcohol injection system suitable for all engine-operating conditions. In contrast to most previous fumigation systems, the method selected used multiple injectors with one at each inlet-valve location. This provided for uniform cylinder-to-cylinder air-alcohol mixtures in order to avoid reduction in energy-replacement potential due to one cylinder setting the limiting condition and allowed the use of different alcohol-injection cycles. The results of the investigation have shown that ethanol fumigation of diesel engines is practical in terms of energy replacement and in terms of proof level of ethanol needed. A two-step injection process allows energy-replacement levels of up to 90% at low loads and 35% at high loads.

21937 **(AD-A—187440/3/XAB) Evaluation of effectiveness of PTFE (polytetrafluoroethylene) type friction reducers on reducing friction and wear.** Guo, Y. (Air Force Systems Command, Wright-Patterson AFB, OH (USA). Foreign Technology Div.). 25 Sep 1987. Trans. of Guti Runhua (China), No. 2, 94-104(1986). (FTD-ID(RS)T—0721-87). 22p. NTIS, PC A03/MF A01.

Friction reducer containing colloidal polytetrafluoroethylene (PTFE) is one of the new lubricating materials recently developed abroad for automobile engines. This paper mainly reports: (1) the effectiveness of friction reducers (three American products and one Chinese product) on the anti-friction and fuel-saving of Chinese multi-cylinder gasoline engines; and (2) the effectiveness of these friction reducers on the anti-wear of Chinese gasoline engines. The evaluations were conducted in Beijing, Shanghai, and Guangdong with identical test procedures. Results obtained from various methods at various places provide a better basis for correlation. These results prove that friction reducers are effective in reducing friction and wear, when applied to Chinese gasoline engines. It was found that the fuel consumption at a constant speed decreased about 4%, the fuel consumption during 100-km operation decreased about 3% and the wear of engine cylinder decreased about 10% to 40%.

3302 External Combustion Engines

REFER ALSO TO CITATION(S) 21409, 22358

21938 **(DOE/NASA/50112—69) Automotive Stirling Engine Development Program: A success.** Tabata, W.K. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1987. Contract AI01-85CE50112. 10p. (NASA-TM—89892; CONF-870804—20). NTIS, PC A02. Order Number DE87010244/JAW.

From 22. intersociety energy conversion engineering conference; Philadelphia, PA, USA (10 Aug 1987).

The original 5 y Automotive Stirling Engine Development Program has been stretched to a 10 y program due to reduced annual funding levels. With an estimated completion date of April 1988, the technical achievements and the prospectives of meeting the original program objectives are reviewed. Various other applications of this developed Stirling engine technology are also discussed.

21939 **(DOE/NASA/50112—73) Hot piston ring/cylinder liner materials: Selection and evaluation: Final report.** Sliney, H.E. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1988. Contract AI01-85CE50112. 17p. (NASA-TM—100276; CONF-880241—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005888/JAW.

From Society of Automotive Engineers international congress and exposition; Detroit, MI, USA (29 Feb 1988).

In current designs of the automotive (kinematic) Stirling engine, the piston rings are made of a reinforced polymer and are located near the bottom of the pistons because they cannot withstand the high temperatures in the upper cylinder region. Theoretically, efficiency could be improved if "hot piston rings" were located near the top of the pistons. This paper describes a program to select piston ring and cylinder coating materials to test this theory. Candidate materials were screened theoretically and in a pin on disk friction and wear test machine. Tests were performed in hydrogen at specimen temperatures up to 760°C to simulate environmental conditions in the region of "hot piston ring" reversal. Based upon the results of these tests, a cobalt based alloy, Stellite 6B, was chosen for the piston rings and PS200, which consists of a metal-bonded chromium carbide matrix with dispersed solid lubricants, was chosen as the cylinder coating. Tests of a modified engine and a baseline engine showed that the hot ring did reduce specific fuel consumption by up to 7% for some operating conditions and averaged about 3% for all conditions evaluated. Related applications of high-temperature coatings for shaft seals and as back-up lubricants for gas bearings are also described. 16 refs., 16 figs.

21940 **(ENEA-RT-FARE—87-2) Theoretical-experimental research on free piston Stirling engines.** Carlini, M.; Conti, M.; Luxardo, P.; Mancini, M.; Mennini, G. (ENEA, Rome (Italy)). Mar 1987. 112p. (In Italian). NTIS (US Sales Only), PC A06. Order Number DE88751893/JAW.

This paper describes the final results of the theoretical-experimental activity carried out in the collaboration agreement between ENEA and the Dipartimento di Meccanica e Aeronautica dell'Universita' di Roma "La Sapienza", concerning the development of free piston Stirling engines. In particular, the influence of different working parameters on engine performance has been investigated and comparisons between the test results and the prediction of the theoretical simulation model have been made.

21941 (NEDOJ—8702, pp 362-397) **Study on multi-purpose stirling engine.** Sep 1987. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770076/JAW.

In FY 1986 NEDO annual report (Part 2).

For practical-use of a stirling engine, the four engine models of 3 KW air conditioner displacer (NS03M), 3 KW air conditioner two-piston (NS03T), 30 KW air conditioner wash plate, and 30 KW small power crank were fabricated as a trial, utilization systems and versatile fuels, as well as the engines, the elements, and the performance, were investigated. In fabrication of an outdoor equipment of the air conditioning system employment of a large bore size enhanced the compression capacity. Additionally, increase in the load to the compressor improved matching to the working portion. Use of pure helium enhanced the engine efficiency, and also the performance significantly. A combustor for methanol fuel was designed and fabricated, followed by subjection to combustion test.

3303 Electric-powered Systems

21942 **(ANL—87-44) Testing and development of electric vehicle batteries for EPRI Electric Transportation Program: Technical report for January 1985-April 1986.** Lee, J. (comp.). (Argonne National Lab., IL (USA)). Jan 1988. Contract W-31109-ENG-38. 54p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88005894/JAW.

The battery is a key element in the acceptance of electric vehicles, and R & D efforts are being undertaken to improve battery performance and lifetime. In this electric-vehicle battery program, controlled laboratory tests were conducted to evaluate the effects of selected factors on the performance and life of the EV-2300 lead-acid battery manufactured by Johnson Controls, Inc. These factors included simulated driving profiles with different levels of peak power demands for vehicle acceleration, long rest times after charge or discharge, and different methods of recharging. The performance and cycle life of a 12-module full-scale battery pack and its support system were also evaluated. This report summarizes the work carried out on this program from January 1985 through April 1986. This work involved tests of the battery pack and support system, statistical analysis of capacity and power data from earlier tests of six-cell modules, and post-test analysis of selected modules and cells. 5 refs., 19 figs., 14 tabs.

21943 **(OA-Trans—2888) High-energy battery for electric road vehicles.** Angelis, J.W.; Birnbreier, H.; Haase, H. Translated from *Elektrotechnische Zeitschrift ;* **108**: No. 14, 658-664(1987). 17p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88900287/JAW.

Brown Boveri have developed a sodium-sulfur battery designed to give a medium-sized saloon car a range of 150 to 250 km, acceleration from 0 to 50 km/h in 7 s and a cruising speed of 120 km/h. The battery has a storage capacity of 32 kWh (2 h rate), a maximum output of 50 kW and an energy density of 120 Wh/kg. Details are given of the electrical and mechanical design of the battery, maintenance of operating temperature, charging arrangements, and the design of the main associated components: drive motor, transmission and power controller. The particular advantages of an electric over a conventional car are regarded as reduced air pollution, less noise and lower energy costs, as shown by a comparative analysis of the two vehicle types. It is anticipated that series production of battery-driven cars will begin in the 1990s. 11 refs., 9 figs., 7 tabs.

3306 Vehicle Design Factors

REFER ALSO TO CITATION(S) 22015

3307 Emission Control

REFER ALSO TO CITATION(S) 21934, 22419, 22983

21944 **(PB—88-133020/XAB) Control of heavy-duty diesel particulate emissions using catalyzed ceramic traps. Final report.** Ullman, T.C. (Southwest Research Inst., San Antonio, TX (USA)). Jun 1987. 88p. (SWRI—8707). NTIS, PC A05/MF A01.

A ceramic particulate filter (trap) was designed as a muffler replacement for application to a GMC RTS II 04 city bus powered by a 2-stroke DDAD 6V-92TAC heavy-duty diesel engine. Preliminary testing indicated that the design was of adequate capacity and filtering efficiency to reduce total particulate by more than 70% and eliminate visible smoke emissions. Three different catalyst formulations were applied to three trap units to enhance on-board trap regeneration. Although some balancing of accumulated particulate with regenerated particulate was obtained below 500C, notable regeneration was not obtained until the catalyzed substrates reached a temperature range of 510 to 550C. The trap units were located before the turbocharger, where high exhaust temperatures, promoted by creating periodic engine upset, could best be utilized for regeneration.

21945 **(PB—88-139878/XAB) Volatile organic compound emissions from 46 in-use passenger cars.** Sigsby, J.E.; Tejada, S.; Ray, W.; Lang, J.M.; Duncan, J.W. (Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab.). 1987. 13p. (EPA—600/J-87/107). NTIS, PC A03/MF A01.

Pub. in Environmental Science and Technology, Vol. 21, No. 5, 466-475(May 1987).

Emissions from automobiles have long been considered a prime source of pollutants involved in smog formation and ozone production. The reactive potential of the species emitted has been studied extensively, and many reactivity schemes have been proposed. Most of the data on the detailed composition of the emissions from automobiles were taken from new or prototype vehicles. This study was undertaken to ascertain the mass and the detailed hydrocarbon and aldehyde composition of emissions from vehicles actually driven by the public. Forty-six vehicles, 1975 through 1982 models, were tested by using the Federal Test Procedure driving cycle, the Hot Soak Evaporative Test, the New York City driving cycle, and the Crowded Urban Expressway driving cycle, also known as the Sulfate Cycle. Overall composition was quite consistent among cycles and years, with some changes occurring in the 1981 and 1982 models. Mass emissions decreased with model year, showing the most significant decreases in latter years as the standards became more stringent. Eighty-two individual hydrocarbons and 10 aldehydes are reported for each test condition. The ratio of hydrocarbons to oxides of nitrogen increased dramatically on the lower speed cycles.

3308 Alternative Fuels

REFER ALSO TO CITATION(S) 21208, 21934

21946 **(CONF-8710116—7) Technical highlights of the Alternative Fuels Utilization Program.** Graves, R.L. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005064/JAW.

From 25. automotive technology development contractor's coordination meeting; Dearborn, MI, USA (26 Oct 1987).

The Alternative Fuels Utilization Program currently encompasses two significant projects in alternative transportation fuels: (1) the Alternative Fuels Utilization Project, a long-range activity of applied research and development, (2) The Federal Methanol Fleet Project, an effort initiated by Congress to introduce methanol vehi-

cles into the fleet of federally-owned vehicles. The overall objectives and summaries of activities are described in this paper.

21947 **(DOE/CS/50028—H1) Alternative fuel performance and emissions characteristics.** (Miami Univ., Coral Gables, FL (USA). Dept. of Mechanical Engineering). Jan 1987. Contract AS05-80CS50028. 114p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88006438/JAW.

This report addresses the question of what problems might be caused by the use of non-petroleum based gasolines in a standard throttle body fuel injection closed-loop spark-ignition internal combustion engine. Five fuels were tested in five separate but physically identical engines. The five fuels were, one baseline unleaded gasoline, two oil shale-derived gasolines, and two coal-derived gasolines. The basic testing of a fuel centered around a 5 hour cycle which was repeated daily until 200 hours of operation were accumulated. The 5 hour cycle was run by alternating every 15 minutes between two distinct conditions. The engines were disassembled and inspected nine times. Additionally, thermal efficiency, regulated emissions, unburnt hydrocarbon makeup, catalyst pressure drop, and cylinder pressure versus crankshaft position measurements were made. Noteworthy differences in the behavior of the fuels in terms of producing deposits that caused intake valve sticking are presented in this report. Additionally, the fuels behaved differently when operated in the presence of knock producing deposits. (R + M)/2 octane numbers proved to be a poor indicator of the fuels knocking behavior. R-M octane numbers proved to be a better indicator of knocking behavior. 16 refs., 43 figs., 29 tabs.

35 ARMS CONTROL

REFER ALSO TO CITATION(S) 22551

21948 **(AD-A—187277/9/XAB) Develop a biomedical data base on the medical aspects of chemical defense. Annual report No. 4, 25 July 1983-24 July 1984.** Landry, L.A.; Schaefer, D.P. (Associate Consultants, Inc., Washington, DC (USA)). 10 Jan 1985. 43p. NTIS, PC A03/MF A01.

Fourth year progress in the development of the computerized Chemical Agent Retrieval System (CARS) data base on selected chemical warfare agents is reported. A prototype data base on soman (GD) was completed, followed by expansion to remaining G-agents, VX, mustard compounds, and lewisite. Development of a thesaurus, and emphasis upon software systems refinement, debugging, and documentation were continued.

21949 **(AD-A—187465/0/XAB) America plans for space.** (National Defense Univ., Washington, DC (USA)). 1986. 201p. NTIS MF A01.

Availability: Superintendent of Documents, GPO, Washington, DC 20402 PC $6.00 Stock no. 008-020-01068-5. Microfiche furnished to DTIC and NTIS users.

Contents include: pursuing a balanced space program; the space defense initiative; warfare in space; the lunar laboratory; the role of space in preserving the peace; living off the land - the use of resources in space for future civilian space operations; the military uses of space; C3I(command control communications and intelligence); aspects of space technology; arms control in space: preserving critical strategic space systems without weapons in space; space and arms control: a skeptical view; options for space arms control; space arms control.

3501 Policy, Negotiations, And Legislation

21950 **(AD-A—187009/6/XAB) Marshal Ogarkov and the new revolution in Soviet military affairs. Research memo.** FitzGerald, M.C. (Center for Naval Analyses, Alexandria, VA (USA). Naval Warfare Operations Div.). 14 Jan 1987. 31p. (CRM—87-2). NTIS, PC A03/MF A01.

When the Soviets accepted Mutual Assured Destruction as a reality in present-day conditions, the Soviet debate on the viability of nuclear war as an instrument of policy was resolved by a consensus: nuclear war is so unpromising and dangerous that it remains an instrument of politics only in theory, an instrument of politics that cannot be used. A growing body of evidence thus indicates that in 1977, coincidentally with Marshal N.V. Ogarkov's elevation to Chief of the General Staff, the Soviets adopted an independent conventional war option as a long-term military development goal. Ogarkov and others now speak of a new revolution in Soviet military affairs that involves changes in Soviet doctrine generated by the so-called emerging technologies and the trend toward new, conventional means. The most-prominent Soviet military figures now equate the new conventional means with nuclear weapons in terms of tasks, ranges, and target sets. A review of Soviet military writings in the 1980s further indicates that the new conventional means will be used in a war that involves neither the territories nor the nuclear forces of the superpowers.

21951 **(AD-A—187170/6/XAB) Nuclear arms control.** Schaefer, H.W. (National Defense Univ., Washington, DC (USA)). Apr 1986. 117p. NTIS MF A01.

Availability: Superintendent of Documents, GPO, Washington, DC 20402 Stock no. 008-020-01059-6 PC $3.25; Microfiche furnished to DTIC and NTIS users.

Limited success in arms-control negotiations has left many in the national defense community frustrated and even pessimistic about the viability of nuclear treaties. Particularly frustrated are arms-control specialists who lack a simplified method for developing clear, defensible negotiating positions. The author thought the problems of arms-control negotiation stemmed from two sources: unclear national security policy, and vague methodologies for formulating negotiating positions; he believed he could do something about the second. This work offers a mathematical process for quantifying the net worth of nuclear arms control factors by addressing the interrelationships among weapons, yields, strategies, and force levels. The author sought to provide the analytical tool that could lead to consensus about the methods, and eventually the goals, of nuclear arms control.

3502 Proliferation

21952 **(AD-A—186907/2/XAB) Impact of deployment rates on the effectiveness of strategic defenses. Master's thesis.** Weber, F.W. (Naval Postgraduate School, Monterey, CA (USA)). Sep 1987. 65p. NTIS, PC A04/MF A01.

The effectiveness of a Ballistic Missile Defense layer of Space-Based Kinetic Kill Vehicles is examined relative to a threat with increasing numbers of Fast-Burn Boosters over the years 1994-2004. A methodology for evaluating Ballistic Missile Defense layer effectiveness and required deployment rates over time is developed.

21953 **The peaceful atom: Lore and myth.** Holl, J.M. (US Dept. of Energy). pp 149-160 of Atoms for peace: An analysis after thirty years. Pilat, J.F.; Pendley, R.E.; Ebinger, C.K. Boulder, CO; Westview Press Inc. (1985). (CONF-8312145—).

From Conference on atoms for peace: an analysis after thirty years; Washington, DC, USA (7 Dec 1983).

On the thirtieth anniversary of President Eisenhower's Atoms for Peace speech, it is appropriate to pause for discussion, reflection, and stocktaking on the meaning and significance of Atoms for Peace today. Like all great historical events there is much that is controversial and contradictory in Atoms for Peace. It has been praised for its boldness, and denounced for its shortsightedness. Atoms for Peace was, and is, a complex event that transcends the 1950s, Eisenhower's party, and U.S. national interest. Nonetheless, Atoms for Peace has developed its own lore and mythology that often shapes, or misshapes, our understanding of its heritage. The author reviews three myths related to Atoms for Peace.

3503 Verification

21954 (PB—88-132451/XAB) Compendium of arms-control verification proposals (Third Edition). Volume 1. Introduction: chapters A to C. Crawford, A.; MacKinnon, G.; Hanson, L.; Morris, E. (Operational Research and Analysis Establishment, Ottawa, Ontario (Canada)). Jun 1987. 445p. (ORAE-EXTRA-MURAL-PAP—42-VOL-1). NTIS, PC E14/MF A01.

See also Volume 2, PB—88-132469, and AD-A124 775.

This three-volume work is intended to serve as a quick-reference catalogue to over 690 arms control-verification proposals originating in the publications and statements of governments and intergovernmental bodies as well as the academic literature on the subject. Each proposal has been abstracted and classified according to two main criteria: the arms control objectives with which it is concerned and the types of verification methods involved. Included are a Subject Index and an Author Index which permit easy access by the reader to any proposal abstract in which he or she may be interested. Chapters in the Compendium are organized according to methods of verification. Each chapter includes an introductory discussion of the method followed by the proposal abstracts which deal prominently with that verification method. A general introduction to the work is also provided.

21955 (PB—88-132469/XAB) Compendium of arms-control verification proposals (Third Edition). Volume 2. Chapters D to J. Crawford, A.; MacKinnon, G.; Hanson, L.; Morris, E. (Operational Research and Analysis Establishment, Ottawa, Ontario (Canada)). Jun 1987. 466p. (ORAE-EXTRA-MURAL-PAP—42-VOL-2). NTIS, PC E15/MF A01.

See also Volume 1, PB—88-132451, and Volume 3, PB—88-132477.

This report contains the following: IAEA safeguards; Progressive/zonal on-site inspection; Control posts; Records monitoring; Non-physical/psychological inspection; Short-range sensors; Remote sensors.

21956 (PB—88-132477/XAB) Compendium of arms-control verification proposals (Third Edition). Volume 3. Chapters K to Q: indexes. Crawford, A.; MacKinnon, G.; Hanson, L.; Morris, E. (Operational Research and Analysis Establishment, Ottawa, Ontario (Canada)). Jun 1987. 452p. (ORAE-EXTRA-MURAL-PAP—42-VOL-3). NTIS, PC E15/MF A01.

See also Volume 2, PB—88-132469.

This report contains the following: Seismic sensors; Literature survey; International exchange of information; National self-supervision; Complaints procedure; International control organization; Review conferences; Author index; Subject index; Index to ENDC, CCD and CD working papers included in the compendium; List of technical working papers on seismic verification not included in the compendium; List of technical working papers on chemical weapons verification not included in the compendium; Supplementary bibliography.

36 MATERIALS

REFER ALSO TO CITATION(S) 22165, 22363

21957 (AECP—1002) Atomic Energy Code of Practice. The coating of surfaces for use in the nuclear industry. (UKAEA Risley Nuclear Power Development Establishment). Jan 1984. 254p. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88750330/JAW.

This Code of Practice provides general advice to designers and others on the factors affecting the choice of coating for use within the nuclear industry. It itemises those design features, which are pertinent to facilitating decontamination and specifies the optimum generic types of coating for a variety of working conditions. Data sheets on commercially available products are included in Section 6 of the Code under the appropriate generic type. Information provided on the data sheets includes a measure of the ease of decontamination of the coating using the accepted method of testing (currently as specified in BS 4247 Part 1) and other nuclear information, where available, i.e. radiation resistance, exhalation rate for radionuclide gases radon and thoron. It also indicates the more important conventional properties of the product.

21958 (IS—4936) Ames Laboratory research report, 1987. (Ames Lab., IA (USA)). 1987. Contract W-7405-ENG-82. 118p. NTIS, PC A06. Order Number DE88004675/JAW.

Research programs of Ames Laboratory are briefly presented. Areas of research include: Quantum chemistry; Excitation Transport; Submicrosecond Thermodynamics; Equations of State; New Techniques and Materials, including ultrasonography coal cleaning and ferromagnets; Applications for Technology Transfer, which includes the development of a copper composite, and use of lasers. 621 refs., 18 figs. (CBS)

21959 (N—88-13609) 58th Shock and Vibration Symposium, volume 1. Pilkey, W.D.; Pilkey, B.F. (National Aeronautics and Space Administration, Huntsville, AL (USA). George C. Marshall Space Flight Center). Oct 1987. 476p. (NASA-CP—2488-VOL-1; M—571-VOL-1; NAS—1.55:2488-VOL-1; CONF-8710126—). NTIS, PC A21/MF A01.

From 58. shock and vibration symposium; Huntsville, AL, USA (13 Oct 1987).

The proceedings of the 58th Shock and Vibration Symposium, held in Huntsville, Alabama, October 13 to 15, 1987 are given. Mechanical shock, dynamic analysis, space shuttle main engine vibration, isolation and damping, and analytical methods are discussed.

3601 Metals And Alloys

REFER ALSO TO CITATION(S) 20789, 20795, 20796, 20797, 20818, 20834, 20858, 20878, 20945, 20948, 20949, 20950, 21050, 21109, 21114, 21440, 21441, 21535, 21540, 21545, 21547, 21574, 21594, 21594, 21595, 21601, 21620, 21919, 22109, 22133, 22187, 22209, 22264, 23734, 23745, 23750, 23755, 23872

21960 (AD-A—187108/6/XAB) Corrosion behavior of high-density tungsten alloys. Final report. Levy, M.; Chang, F.C. (Army Materials Research Agency, Watertown, MA (USA). Materials Technology Lab.). Aug 1987. 16p. (MTL-TR—87-37). NTIS, PC A03/MF A01.

The corrosion behavior of high-density tungsten alloys was examined by electrochemical potentiostatic polarization methods and weight-loss measurements in full-immersion tests. Electrochemical tests were carried out in aqueous solutions, buffered to pH 4, 9, 12 with and without 0.1M sodium chloride and immersion tests in 5% NaCl solution. Pure tungsten and all the alloys studied undergo active-passive transitions and corrosion rates increase with increasing pH. The chloride ion generally increases corrosion rates slightly, but in pH12 solution, the chloride ion inhibits the anodic reaction to some extent. A 97N-2Ni-0.7Fe-0-3Co alloy was found to be the most corrosion resistant in solutions containing chloride ions. The data also suggests that copper as an alloying element accelerates corrosion of tungsten alloys in NaCl solution. Both general dissolution and localized attack at grain boundaries were observed.

21961 (AD-A—187239/9/XAB) Effects of ion implantation on cavitation erosion of a cobalt-based metal/carbide alloy. Final report, 1 June 1986-30 August 1987. Dillich, S.A. (Worcester Polytechnic Inst., MA (USA). Dept. of Mechanical Engineering). Sep 1987. 65p. NTIS, PC A04/MF A01.

The goal of this work was to characterize the cavitation erosion wear mechanisms in a cobalt-based superalloy and to investigate how these could be altered by high-fluence titanium and nitrogen implantations. Both titanium and nickel implantations significantly improved the cavitation erosion resistance of the alloy, primarily through implantation effects in the cobalt-rich matrix phase. The titanium-implanted samples showed the highest erosion resistances, as a result of the microstructural changes produced in the alloy during implantation. Namely, a carburized surface layer was formed, with an amorphous matrix phase and recrystallized car-

bides. A corresponding toughening of the matrix phase and decrease in the elastic modulus difference between matrix and carbide phases can account for the observed increased erosion resistance of this phase and enhanced carbide-matrix cohesion. Nitrogen implantation stabilized the metastable fcc matrix phase of the alloy... (i.e., inhibited stress induced martensitic facc to hcp transformations in the cobalt rich phase) with consequent prolonged matrix phase ductility and decreased carbide-matrix debonding during cavitation erosion.

21962 **(AD-A—187262/1/XAB) Corrosion behavior of sputter-deposited aluminum-based alloys exposed to chloride solutions. Annual report, 1 July 1986-30 June 1987.** Moshier, W.C.; Davis, G.D.; Cote, G.O.; Hough, H.F.; Vogelsang, M.E. (Martin Marietta Labs., Baltimore, MD (USA)). 30 Sep 1987. 42p. (MML-TR—87-75C). NTIS, PC A03/MF A01.

In the second year of the program, the investigation of the passivity of sputter-deposited Al alloys has been extended from Al-Mo and Al-Cr to include Al-Ta, Al-Zr, Al-Si, and Al-Cu. Al-Ta was found to have the greatest effect on the breakdown potential of Al. Al-Mo, Al-Zr, and Al-Cr also substantially impact the breakdown potential, whereas Al-Cu and Al-Si have little or no effect. A more extensive study of the corrosion behavior of Al-Mo and Al-Cr was performed in salt spray and pit initiation tests. Whereas the Al-Cr alloys outperformed the Al-Mo alloys in the salt spray tests, Whereas the Al-Cr alloys outperformed the Al-Mo alloys in the salt spray tests, both alloys were substantially more resistant to attack than pure aluminum. Pit initiation tests showed that the order of the reaction between the alloys and pure Al was identical. However, the time required to initiate a pit was substantially longer for Al-Mo than for Al-Cr or pure Al, indicating that the mechanism by which pits nucleate and grow through the film may be different.

21963 **(AD-A—187563/2/XAB) Superconductivity of thin-film intermetallic compounds. Technical report (Final), 1 September 1986-31 August 1987.** Goldman, A.M. (Minnesota Univ., Minneapolis (USA). School of Physics and Astronomy). 30 Sep 1987. 33p. NTIS, PC A03/MF A01.

Investigations of both macroscopic and microscopic properties of thin-film superconducting materials have been carried out. Compounds under study prior to the discovery of high-T/sub c/ superconductors, were either technologically significant, or involved possible unique mechanisms for superconductivity whose realization might extend the range of critical parameters. These include low-carrier-density superconductors, selected Heavy Fermion Compounds, and Chevrel Phase superconductors. Among the low-carrier density systems were films of lead-tellurium and mixtures of lanthanium sulfide. These were prepared with the idea of ultimately fabricating FET-like devices. Films of the Heavy Fermion Compounds UPt_3 and UBe_{13} were prepared and the critical fields and proximity effects in the latter were studied. With the advent of the high-T/sub c/ materials the program shifted to their study and measurements of their time-dependent magnetization, XPS spectra, and tunneling spectra were carried out on both bulk and thin film materials.

21964 **(AERE-R—12480) Evaluation of tie down coatings for alpha active applications.** Dalton, J.T.; Sutcliffe, P.W.; Wilkins, R.I.; Turner, A.D. (UKAEA Harwell Lab. Chemistry Div.). Oct 1987. 14p. (DDTF—P-104; PCMRP—86-P11; DOE-RW—87.043). H.M. Stationery Office, London, price Pound 4.00.

The small scale experiments are described which quantify the reduction in airborne contamination, that was resuspended when plutonium oxide contaminated samples were vibrated, as a result of applying a tie-down coating. Comparable performance in reducing PuO/sub 2/ resuspension was shown by both Spraylat 100, a water soluble tie-down coating and Avigel 108, dissolved in methylene chloride, irrespective of whether the stainless steel or epoxide painted mild steel samples were mechanically damaged, degreased or smeared with an oil film prior to coating application. Re-suspension was reduced by a factor of ca 400 to values that are ca 1 x 10/sup -3/% of the initial contamination level.

21965 **(BA-AWD-HX—1857-001-TR) Offshore wind turbine generators. Fatigue testing programmes for coated materials in salt spray environments.** Thurgood, D.A. (comp.). (UKAEA Harwell Lab. Energy Technology Div.). Feb 1986. 57p. (ETSU-WN—5010-P1). British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

A limited investigation was conducted to establish the relative merits of corrosion protection systems applied to mild steel specimens representative of fabricated wind turbine rotor blades operating in a salt spray environment. Using cantilever bending specimens for high cycle fatigue crack initiation, and compact tension specimens for crack propagation, the programmes demonstrated no particular advantage of either protective treatment, with a slight preference for aluminium metal spray rather than hot dip zinc galvanising where propagation of larger cracks would be permitted in normal operational use.

21966 **(BNL—40534) Studies of transverse phonon modes in premartensitic indium-thallium alloys.** Finlayson, T.R.; Donovan, D.; Larese, J.Z.; Smith, H.G. (Brookhaven National Lab., Upton, NY (USA); Monash Univ., Clayton (Australia). Dept. of Physics; Pennsylvania State Univ., University Park (USA). Materials Research Lab.; Oak Ridge National Lab., TN (USA)). 1987. Contract AC02-76CH00016;AC05-84OR21400. 6p. (CONF-8708199—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003481/JAW.

From International symposium of neutron scattering: advances and applications; Aedermaunsdorf, Switzerland (8 Aug 1987).

The measured phonon dispersion relations along the high symmetry directions for a face-centered In-Tl alloy have been reasonably well fitted using a general Born-von Karman force constant model. However, for the [zeta zeta 0][zeta anti zeta 0] branch at low zeta, there is poor agreement between the neutron measurements and the extrapolation of the line of initial slope determined from an ultrasonic velocity measurements. Phonon frequencies have been measured for wave vectors to within $q = 0.033\ (\sqrt{2}\ 2\pi/a)$ of the zone centre, and, contrary to the phonon softening with decreasing temperature, which might be expected from the known decrease in $(C_{11} - C_{12})/2$, phonon frequencies showed the normal trend of frequency increasing (hardening) as temperature was decreased in the premartensitic regime. To reconcile the disagreement between the extrapolation of the ultrasonic data and the measured [zeta zeta0][zeta anti zeta 0] phonon frequencies, there must exist a positive curvature in the dispersion relation at $q < 0.03\ (\sqrt{2}\ 2\pi/a)$. This is consistent with one recent theory for martensite nucleation. 10 refs., 2 figs.

21967 **(CBPF-NF—045/87) /sup 57/Fe Moessbauer study of the superconductor YBa/sub 2/ (Fe/sub x/ Cu/sub 1-x/)/sub 3/O/sub y/.** Saitovitch, E.M.B.; Azevedo, I.S.; Scorzelli, R.B.; Saitovitch, H.; Cunha, S.F. da; Guimaraes, A.P.; Silva, P.R.; Takeushi, A.Y. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1987. 24p. NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701543/JAW.

/sup 57/Fe Mossbauer Spectroscopy measurements were made on the YBa/sub 2/(Fe/sub x/Cu/sub 1-x/)/sub 3/O/sub y/ superconducting compounds, for the Fe concentrations of 0.1%, 0,5%, 3.0% and 10%. The Mossbauer spectra, obtained at room temperature and at 4.2 K, are dependent on concentration and show several doublets that can be related to different Cu sites, to the number of oxygen vacancies, and to the presence of a high temperature tetragonal phase. This analysis is based on the values of the quadrupole interactions and on the ratio of the absorption areas. Two Mossbauer doublets in the dilute samples (up to 1.0% Fe) are associated to /sup 57/Fe in the Cu/sub 1/ site of the compound. The 4.2 K spectra of the more concentrated samples (3.0% and 10% Fe) show spin relaxation effects indicating that iron has a magnetic moment. Magnetic susceptibility measurements show, with increasing ironoment. Magnetic susceptibility measurements show, with increasing ironconcentration, a decrease in chemical bondX/sub g/chemical bond at 77 K and in increasing ironchemical bond/sup dXg/-/sub dT/ near Tc. (M.W:O.).

21968 (CEA-CONF—8996) Radiation damage correlations and dosimetry. Alberman, A.; Dierckx, P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Inst. de Recherche Technologique et de Developpement Industriel (IRDI)). Jun 1987. 5p. (CONF-870501—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88752134/JAW.

From 6. ASTM-Euratom symposium on reactor dosimetry; Jackson Hole, WY, USA (31 May 1987).

21969 (CEA-R—5377) Theoretical study of defect properties in metals. Sindzingre, P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Inst. de Recherche Technologique et de Developpement Industriel (IRDI)). Jan 1987. 245p. (In French). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88752107/JAW.

Several characteristic properties (formation and migration enthalpies and volumes, dipole tensors, effects on shear elastic constants) of several point defects (vacancy, divacancy, interstitial, di-interstitial) in different metals: f.c.c. metals (Al, Cu, Ag, Au), h.c.p. metals (Be, Mg, Zn, Cd, Na, Co, Ti, Zr), b.c.c. metals (Li, Na, K, Rb, Cs) have been calculated. The calculated properties are evaluated from static computations performed with pair potentials derived from pseudo-potential theory (for simple or noble metals) or deduced empirically. Results are compared with available experimental data with previous theoretical works. The first part of this work where we have studied point defects properties in f.c.c. metals lead us to suggest a more convincing interpretation of X-ray scattering and elastic relation measurements concerning interstitials in Al and Cu, and a new interpretation for X-ray scattering measurements concerning di-interstitials in Al. In the second part, devoted to h.c.p. metals we are brought to propose for each studied metal the interstitial configurations which yield the best agreement with experimental results. The third part, devoted to the study of point defects in alkalin b.c.c. metals lead us to interpret self-diffusion in these metals with the assumption of a simultaneous contribution of monovacancies, divacancies and interstitials.

21970 (CONF-871124—74) Temperature dependence of Kr precipitation in Ni. Birtcher, R.C.; Liu, A.S. (Argonne National Lab., IL (USA)). Nov 1987. Contract W-31109-ENG-38. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005953/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (30 Nov 1987).

The precipitation of Kr injected into Ni at temperatures between 25 and 560°C has been studied with transmission electron microscopy. The Kr precipitates in cavities which increase in size with Kr fluence. Electron diffraction and dark-field imaging demonstrate that small Kr precipitates are solid, fcc crystals aligned with each other and the Ni lattice. The Kr is held in the solid state by the pressure generated by the cavity walls, and this pressure decreases with increasing cavity size. The mismatch between the Kr and Ni lattices is as large as 55%. The average Kr lattice parameter, determined from electron diffraction at room temperature, increases with increasing Kr fluence from 0.515 nm to an asymptotic value of about 0.545 nm for implantations at temperatures of 300 C or less. This increase towards an asymptotic limit is due to expansion of the Kr lattices as precipitates grow, until the decrease in cavity pressures allows melting of solid Kr in large cavities. Diffuse electron scattering was observed from liquid Kr in large precipitates for fluences greater than $5 \cdot 10^{20} Kr^{+} m^{-2}$. Implantations at temperatures of 400 C or higher result in a bi-modal size distribution containing small solid precipitates and an additional population of larger, faceted precipitates, a larger average Kr lattice parameter for a given Kr fluence, and a higher asymptotic lattice parameter of 0.550 nm. Solid Kr seems to inhibit motion of small precipitates, and Kr melting is a precursor to faceting and growth by coalescence. 10 refs., 3 figs.

21971 (CONF-871124—81) The projectile mass dependence of the amorphization process and the critical temperature in the ion irradiated CuTi. Koike, J.; Okamoto, P.R.; Meshii, M. (Northwestern Univ., Evanston, IL (USA). Dept. of Materials Science and Engineering; Argonne National Lab., IL (USA)). Jan 1988. Contract W-31109-ENG-38. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005975/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (30 Nov 1987).

CuTi was irradiated with 1MeV Ne^{+} and Kr^{+} at various temperatures in the Argonne-HVEM interfaced to a tandem accelerator. The integrated intensity of diffuse ring was measured by a microdensitometer and analyzed by Gibbons model for the dose dependence of the amorphous volume. The results indicate that the direct amorphization occurs in a single damage zone with Kr^{+}, but the overlapping of three damage zones is necessary with Ne^{+}. The critical temperature for amorphization was 401 +- 22K for Ne^{+} and 543 +- 20K for Kr^{+}, respectively. With Kr^{+}, the critical temperature was nearly equal to the thermal crystallization temperature of an amorphous zone embedded in the crystalline matrix. Using the present observations, the relation between the amorphization process and the critical temperature is discussed. 20 refs., 4 figs., 1 tab.

21972 (CONF-880314—2) Response of aluminum alloys to erosive particle impacts. Keiser, J.R.; Heidersbach, R.S.; Dobbs, D.L.; Oliver, W.C. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 12p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005910/JAW.

From National Association of Corrosion Engineers meeting; St. Louis, MO, USA (21 Mar 1988).

Erosive particle impacts can result in the high-strain-rate deposition of an appreciable amount of energy into the defromed volume of the target material. This energy likely causes local heating; softening or even melting has been observed in many materials. Hardening caused by the high-strain-rate deformation has also been reported for strain-hardenable materials. The effect of individual impacts on the surface of selected aluminum alloys was determined both analyticaly using theoretical considerations and experimentally using 343-μm-diam tungsten carbide balls impacting at about 30 m/s and 30° incidence angle. After impact a mechanical properties microprobe was used to measure the hardness of both the crater bottom and material just below the original surface. Strain hardening, but no evidence of softening, was observed for two aluminum alloys. 29 refs., 6 figs., 1 tab.

21973 (CONF-8706103—7) Annihilation momentum density of positrons trapped at vacancy-type defects in metals and alloys. Bansil, A.; Prasad, R.; Benedek, R. (Northeastern Univ., Boston, MA (USA). Dept. of Physics; Indian Inst. of Tech., Kanpur. Dept. of Physics; Argonne National Lab., IL (USA)). Jan 1988. Contract W-31109-ENG-38. 7p. NTIS, PC A02. Order Number DE88005936/JAW.

From NATO advanced study institute on alloy phase stability; Crete, Greece (14 Jun 1987).

Positron annihilation, especially the angular correlation of annihilation radiation, is a powerful tool for investigating the electronic spectra of ordered as well as defected materials. The tendency of positrons to trap at vacancy-type defects should enable this technique to study the local environment of such defects. However, we need to develop a theoretical basis for calculating the two-photon annihilation momentum density rho/sub 2gamma/(p-vector). We have recently formulated and implemented a theory of rho/sub 2gamma/(p-vector) from vacancy-type defects in metals and alloys. This article gives an outline of our approach together with a few of our results. Section 2 summarizes the basic equations for evaluating rho/sub 2gamma/(p-vector). Our Green's function-based approach is nonperturbative and employs a realistic (one-particle) muffin-tin Hamiltonian for treating electrons and positrons. Section 3 presents and discusses rho/sub 2gamma/(p-vector) results for a mono-vacancy in Cu. We have neglected the effects of electron-positron correlations and of lattice distortion around the vacancy. Section 4 comments briefly on the question of treating defects such as divacancies and metal-impurity complexes in metals

and alloys. Finally, in Section 5, we remark on the form of rho/sub 2gamma/(p-vector) for a mono-vacancy in jellium. 2 figs.

21974 **(CONF-8710219—2) Tracer diffusion of ^{60}Co and ^{63}Ni in amorphous NiZr alloy.** Hoshino, K.; Averback, R.S.; Hahn, H.; Rothman, S.J. (Illinois Univ., Urbana (USA); Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 8p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88005946/JAW.

From Symposium on diffusion processes in high technology materials; Cincinnati, OH, USA (12 Oct 1987).

Tracer diffusion of ^{60}Co and ^{63}Ni in equiatomic amorphous NiZr alloy in the temperature range between 486 and 641°K can be described by: D/sub Co/sup */ = 3.7 x 10^{-7} exp[-(135 +- 14) kJ $mole^{-1}$/RT] m^2/sec and D/sub Ni//sup */ = 1.7 x 10^{-7} exp[-(140 +- 9) kJ $mole^{-1}$/RT] m^2/sec. The values of D/sub Ni//sup */ are in reasonable agreement with those measured by the Rutherford backscattering technique. The measured diffusivities were independent of time, indicating that no relaxation took place during diffusion. 27 refs., 2 tabs.

21975 **(DOE/ER/45109—T1) [The fatigue behavior of ferritic and austenitic steels at elevated temperatures: Progress report].** McEvily, A.J. (Connecticut Univ., Storrs (USA)). [1988]. Contract FG02-84ER45109. 12p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006304/JAW.

With type 304 austenitic steel we have observed no creep-fatigue interactions down to a frequency of 0.3 Hz. Crack closure occurs in 304 stainless at 538°C, whereas it does not in the ferritic alloys investigated. This is attributed to the greater resistance to creep of the austenitic material. The 304 material has also been studied at room temperature with interesting results. Stress-induced phase transformation affects the nature of the crack closure process. In addition it reduces markedly the fatigue notch sensitivity of this alloy. With the 9Cr-2Mo ferritic alloy, a decrease in specimen thickness results in an increase in crack closure and a decrease in crack growth rate. 2 figs.

21976 **(DOE/ER/45173—4) Corrosion Research Center, University of Minnesota: Final report, September 1, 1985-October 31, 1987.** Oriani, R.A. (Minnesota Univ., Minneapolis (USA)). Feb 1988. Contract FG02-84ER45173. 56p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88006681/JAW.

Research projects have included investigation of stresses and their relaxation during high-temperature oxidation, hot corrosion, basic studies of the plasma spray process, application of many-body theory to corrosion phenomena, electrochemical passivation, electrochemical modeling, photoelectrochemistry of oxides, electronically conducting polymers, microelectrodes, and investigation of the electrode/electrolyte interface.

21977 **(EGG-MS—7570) Evaluation of damaged tank car structural integrity.** Reuter, W.G.; Mudlin, J.D.; Harris, B.L.; Haggag, F.M.; Epstein, J.S.; Server, W.L. (EG and G Idaho, Inc., Idaho Falls (USA)). Jun 1987. Contract AC07-76ID01570. 115p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88005551/JAW.

To assess the safety of moving a damaged tank car, it is necessary to know the sizes and shapes of cracks, the stresses associated with moving the tank car, and the fracture toughness of the material used to fabricate the tank car. This report provides the results and recommendations for the research related to the examination of nondestructive evaluation techniques and measurements of the mechanical properties of deformed steel plate; Evaluation of computer codes to identify those capable of performing a large displacement inelastic analysis; Two 1/5-scale-model tank cars, representing damaged tank cars that were hydroburst to failure; and Preliminary tests conducted using more interferometry for determining residual stresses of rail components. 24 refs., 37 figs., 4 tabs.

21978 **(EPRI-CS—5605) Multitechnique corrosion monitoring in flue gas desulfurization systems: Phase 1, Interim report.** Gearey, D.; Cox, W.M. (University of Manchester Inst. of Science and Technology (UK). Corrosion and Protection Centre Industrial Services). Jan 1988. 152p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920162/JAW.

Advanced electrochemical corrosion monitoring equipment has been used to investigate the effect of short term changes in process conditions in FGD systems. Laminar flush mounted electrochemical probes, fabricated from Type 316L stainless steel were exposed in the flue gas environment of a model scrubber at the LaQue Center for Corrosion Technology, Inc. (LCCT) and an operating dual alkali scrubber system at the R.M. Schahfer Generating Station. The monitoring system employed a combination of electrochemical impedance, zero resistance ammetry, electrochemical potential noise and coupling current noise to identify the degree of corrosivity of the outlet duct environment and pit initiation and propagation characteristics of the stainless steel. Monitored trends of corrosion were confirmed by coupon exposure and visual inspection but the electrochemical methods were able to identify that short term variations in process conditions were responsible for the corrosion damage. The pitting type corrosion was linked to the deposit of salts in conjunction with the absorption of moisture. Thus, cycling of parts of the system through a wet/dry condition is largely responsible for the corrosion. A fall in temperature of less than 10°F (5°C) is sufficient to cause a humidity rise which stimulates the corrosion under the deposits. 10 refs., 88 figs., 6 tabs.

21979 **(EUR—10567) High temperature alloys for gas turbines and other applications 1986. Two parts.** Betz, W.; Brunetaud, R.; Coutsouradis, D.; Fischmeister, H.; Gibbons, T.B.; Kvernes, I.; Lindblom, Y.; Marriott, J.B.; Meadowcroft, D.B. (eds.). (Reidel (D.) Publishing Co., Dordrecht (Netherlands)). 1986. 1702p. (CONF-861025—). D. Reidel Publishing Company, Dordrecht, Netherlands.

From 3. conference on high temperature alloys for gas turbines and other applications; Liege, Belgium (6 Oct 1986).

A total of 105 papers were presented at the conference in 14 sessions with the following headings: developments in materials and processing; environmental effects and protection; mechanical properties for engineering design; solidfication and casting; joining and repair; forging and powder metallurgy; materials; ODS materials; corrosion; protective systems; combined stress - environmental effects; creep; fatigue and creep fatigue; life time prediction. 4 of the papers have been abstracted separately.

21980 **(FLPU—86-10) Studies on the effects of sulphate-reducing bacteria on mild carbon-steel relevant to radioactive waste disposal in the UK.** Philp, J.C.; Christofi, N.; Taylor, K.J.; West, J.M. (British Geological Survey, Keyworth. Fluid Processes Research Group; Department of the Environment, London (UK)). 1987. 62p. (DOE-RW—87.065). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88752359/JAW.

Sulphate-reducing bacteria (SRB) have been used to determine their maximum effect on mild carbon-steel (BS4360 grade 43A) of relevance to waste disposal. Batch (static) and continuous culture studies were carried out and corrosion effects monitored by measuring weight loss and pitting. Results show that corrosion increases linearly with increased ferrous iron concentrations. Maximum corrosion was obtained in continuous culture where the organisms were maintained in the exponential phase of growth. Corrosion by SRB has been monitored in model systems mimicking low groundwater flow, deep rock formations in which steel coupons were subjected to a synthetic granitic water/bentonite environment with or without microorganisms. At termination of the experiment corrosion in the presence of SRB was almost three times higher than in their absence.

21981 **(IAE—4351/11) Study of residual electric resistance restoring in irradiated and deformed vessel steel.** Platonov, P.A.; Amaev, A.D.; Tursunov, I.E.; Krasikov, E.A.; Levit, V.I.; Nikitin, S.V.; Biryukov, A.Yu. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1986. 16p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701031/JAW.

Investigation into residual electric resistance (RER) restoring under isochronous and isothermal annealing of 15Kh2MFA pearlitic steel irradiated at 260 and 220 deg C has been represented in the paper RER restoring occurs, mainly, during two stages, at that a RER restoring value depends on irradiation temperature. Thermoactivation analysis and results of studying the fracture surface of hydrogenated steel permit to affirm that pearlitic steel irradiation at the given temperatures leading to RER drop in a certain measure is related to formation of phosphorus grain-boundary aggregations. It is established that the deformation of steel irradiated at a temperature of about 260 deg C causes additive RER change, which permits to suggest schemes for solution of some practical problems. 24 refs.; 10 figs.; 3 tabs.

21982 **(IAEA-R—3650-F) Study of defects in metals by positron annihilation. Final report for the period December 1983-December 1986.** Ayres de Campos, N. (International Atomic Energy Agency, Vienna (Austria)). Oct 1987. 4p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701042/JAW.

Two techniques of positron annihilation, Doppler broadening and life-time measurements, were applied to studies of radiation damage effects in steels. The defects created in irradiation with deuterons and neutrons were observed at different stages of the annealing process, at different temperatures. The comparison with TEM was made. The vacancy clusters created in AISI316 steel by deuteron irradiation were observed to dissolve completely at 550 deg. C. The presence of deuterium in material has no influence on stabilization of these clusters. The neutron irradiation of steel, with the dose of 2 x 10E19 neutrons/sqcm formed in A533B steel microcavities containing around ten single vacancies. At 400 deg. C the shape decrease in positron trapping indicates a complete annealing; simultaneously, changes in the structure of carbide precipitates were observed. An interpretative model for these results was developed. 7 refs.

21983 **(IEN-DIAPQ—07/87) Fast boron analysis method.** Rezende, P.R. de. (Instituto de Engenharia Nuclear, Rio de Janeiro (Brazil)). 1987. 8p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701577/JAW.

Fast method of boron molar concentration analysis in hydrochloric medium (0,1N), that could be used 'on line' on boron improvement plant was studied. (LMJ).

21984 **(INIS-GB—90) Radiation-induced sensitisation of stainless steels. Proceedings of symposium.** Norris, D.I.R. (ed.). (Central Electricity Generating Board, London (UK); Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). 1987. 142p. (CONF-8609307—). NTIS (US Sales Only), PC A07/MF A01. Order Number DE87752852/JAW.

From Symposium on radiation-induced sensitization of stainless steels; Berkeley, UK (23 Sep 1986).

The book contains the proceedings of a symposium on radiation-induced sensitization of stainless steels, which took place at Berkeley, United Kingdom, 1986. The purpose of the symposium was to examine the mechanism leading to inter-granular corrosion of 20%Cr/25%Ni/Nb stainless steel cladding of AGR fuel following irradiation. Nine papers are presented, of which three are theoretical, two papers are based upon corrosion studies of 20%Cr/25%Ni/Nb steel, and the remaining are concerned with compositional redistribution and its measurement. (U.K.).

21985 **(INIS-GB—90, pp 3-14) Theories of atom movements in alloys.** Lidiard, A.B. (UKAEA Atomic Energy Research Establishment, Harwell. Theoretical Physics Div.). 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE87752852/JAW. (CONF-8609307—).

From Symposium on radiation-induced sensitization of stainless steels; Berkeley, UK (23 Sep 1986).

The object of the paper is to show how theories of atomic transport in alloys close to thermodynamic equilibrium can be adapted to describe transport in alloys under irradiation. This is carried out within the context provided by non-equilibrium thermodynamics and by recent statistical theories of the transport coefficients which arise in that formulation. Both dilute and concentrated alloys are considered (the latter as represented by the random alloy model). It is shown that one particular group of calculations for random alloy models is unnecessarily restricted in the assumptions made and that considerably more accurate predictions are likely to follow from an adaptation of the Manning theory of the random alloy.

21986 **(INIS-GB—90, pp 15-34) Fundamental aspects of radiation-induced segregation in Fe-Cr-Ni alloys.** Perks, J.M.; English, C.A.; Marwick, A.D. (UKAEA Atomic Energy Research Establishment, Harwell; IBM Watson Research Center, Yorktown Heights, NY, USA). 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE87752852/JAW. (CONF-8609307—).

From Symposium on radiation-induced sensitization of stainless steels; Berkeley, UK (23 Sep 1986).

The mechanisms of radiation-induced segregation are discussed and a model to predict the major element segregation of Fe-Cr-Ni ternary alloys under irradiation is described. The model is compared to experimental data and then used to predict the segregation behaviour of a Fe-20Cr-25Ni alloy, similar to the steel used for CAGR fuel cladding, over a wide range of irradiation conditions. The model has then been used to predict the effect of a post-irradiation anneal on the same alloy. The composition dependence of the segregation is examined. Finally the limitations of the model are discussed and further improvements suggested.

21987 **(INIS-GB—90, pp 35-42) Theoretical modelling of segregation in dilute alloys.** Murphy, S.M. (UKAEA Atomic Energy Research Establishment, Harwell. Theoretical Physics Div.). 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE87752852/JAW. (CONF-8609307—).

From Symposium on radiation-induced sensitization of stainless steels; Berkeley, UK (23 Sep 1986).

A model for segregation in dilute alloys is briefly described. The work is based on the kinetic theory of diffusion and includes the effects of the binding of vacancies and interstitials to solute atoms. Expressions for the fluxes of solute atoms, vacancies and interstitials are given. Also, preliminary results of this model for the segregation of silicon in nickel are described. In this case both vacancies and interstitials are strongly bound to solute atoms, and even when the concentration of solute is low a large proportion of the point defects are trapped by solute atoms. The model predicts strong segregation of silicon to a free surface, and the migration of the vacancies and interstitials are also strongly influenced by the presence of silicon.

21988 **(INIS-GB—90, pp 43-59) Thermal sensitisation of 20Cr/25Ni/Nb stainless steel.** Moss, C.J.; Sykes, J.M. (Oxford Univ., UK. Dept. of Metallurgy and Science of Materials). 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE87752852/JAW. (CONF-8609307—).

From Symposium on radiation-induced sensitization of stainless steels; Berkeley, UK (23 Sep 1986).

Artificial sensitisation of 20Cr/25Ni/Nb steel by thermal treatment has been studied using modified Strauss tests and Electrochemical Potentiokinetic Reactivation (EPR) tests. A high degree of sensitisation was obtained in A.G.R. fuel can samples using a 1/2h solution treatment at 1050°C followed by ageing for 500h at 550°C, or by ageing 50h at 600°C after a solution treatment at 1150°C. A 5h treatment at 650°C gave sensitisation for either solution treatment. When bar-stock to the same specification was investigated no sensitisation, detectable in a Strauss test, could be ob-

tained. The E.P.R. test showed a response even for bar material and allowed the results of different treatments to be differentiated.

21989 (INIS-GB—90, pp 60-73) **Formation of sensitised microstructures during the irradiation of CAGR fuel pin cladding.** Taylor, C. (UKAEA Windscale Nuclear Power Development Labs.). 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE87752852/JAW. (CONF-8609307—).

From Symposium on radiation-induced sensitization of stainless steels; Berkeley, UK (23 Sep 1986).

The paper concerns the irradiation conditions under which sensitised microstructures form at different positions through the wall of Commerical AGR (CAGR) fuel pin cladding. A corrosion test was applied to small coupons of cladding removed from fuel pins irradiated to Stringer Mean Irradiations (SMI) of 8.1 to 20.7 G Wd/teU, in various CAGR. The results reveal that corrosion was liable to occur throughout the wall over the temperature range 350° - 500°C with peak sensitization developing at about 400°C. It is concluded that sensitised structures form as a consequence of irradiation-induced segregation effects through the wall and additionally via C pick up, and the consequential precipitation of Cr-rich precipitation at the outer sub-surface. (U.K.)

21990 (INIS-GB—90, pp 74-85) **Measurement of radiation-induced segregation profiles by high spatial resolution electron microscopy.** Titchmarsh, J.M.; Vatter, I.A. (UKAEA Atomic Energy Research Establishment, Harwell. Materials Physics and Metallurgy Div.). 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE87752852/JAW. (CONF-8609307—).

From Symposium on radiation-induced sensitization of stainless steels; Berkeley, UK (23 Sep 1986).

The paper concerns analytical electron microscopy (AEM) experimental procedures required for measuring concentration profiles across grain boundaries in irradiated steels. Requirements for obtaining high spatial resolution profiles using x-ray analysis are described, and examples of profiles with high spatial resolution are given. The interpretation of data on concentration profiles is outlined, as well as the use of electron energy loss spectroscopy. Examples of chemical compositional profiles with high spatial resolution are included to illustrate the capability of AEM. (U.K.)

21991 (INIS-GB—90, pp 86-98) **Compositional profiles at grain boundaries in 20%Cr/25%Ni/Nb stainless steel.** Norris, D.I.R.; Baker, C.; Titchmarsh, J.M. (Central Electricity Generating Board, Berkeley, UK. Berkeley Nuclear Labs.; UKAEA Atomic Energy Research Establishment, Harwell). 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE87752852/JAW. (CONF-8609307—).

From Symposium on radiation-induced sensitization of stainless steels; Berkeley, UK (23 Sep 1986).

The paper reports compositional profile measurements in the 20%Cr/25%Ni/Nb stabilised steel used as Commerical AGR (CAGR) fuel pin cladding. The variations of chromium, iron, nickel and silicon concentrations along scans traversely across grain boundaries have been determined using analytical electron microscopy. The profiles for can mid-wall samples from a CAGR stringer at a mean irradiation of 12.45 GWd/teU became wider in extent and smaller intensity with irradiation temperature over the range 353-481°C. A model is used to interpret the results. The results suggest that differential vacancy migration is due to different migration energies. Diffusion rates from the measured profiles and widths of chromium - depleted zones, indicate that the model can be used, with some limitations, to predict the post-irradiation corrosion behaviour of 20/25/Nb stainless steel for given irradiation conditions and times. (U.K.)

21992 (INIS-GB—90, pp 99-155) **Radiation-induced segregation in ferritic steels.** Mahon, G.J.; Nicholls, A.W.; Jones, I.P.; English, C.A.; Williams, T.M. (Birmingham Univ., UK. Dept. of Metallurgy and Materials; UKAEA Atomic Energy Research Establishment, Harwell. Materials Development Div.). 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE87752852/JAW. (CONF-8609307—).

From Symposium on radiation-induced sensitization of stainless steels; Berkeley, UK (23 Sep 1986).

Radiation-induced solute segregation has been studied in a series of ferritic stainless steels based on the iron-12% chromium binary. Irradiations have been performed using the simulation techniques of heavy-ion and electron irradiation to doses of 10 dpa. Solute redistribution to grain boundaries has been detected in a fully ferritic microstructure using an electron microscope operating in the scanning transmission mode. Segregation profiles have been obtained across the irradiated boundaries. The following solute redistribution is detected in the alloys investigated:- depletion of chromium, vanadium and molybdenum, enrichment of nickel, silicon and phosphorus. This segregation is accounted for using the established mechanisms of solute redistribution during irradiation. Radiation-induced segregation has been detected in the temperature range 350-650°C in the high voltage electron microscope, the maximum redistribution occurring at 550°C.

21993 (INIS-GB—90, pp 116-134) **Compositional redistribution in irradiated austenitic steels and consequent changes in microstructure.** Williams, T.M.; Boothby, R.M.; Titchmarsh, J.M. (IKAEA Atomic Energy Research Establishment, Harwell. Materials Development Div.; UKAEA Atomic Energy Research Establishment, Harwell. Materials Physics and Metallurgy Div.). 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE87752852/JAW. (CONF-8609307—).

From Symposium on radiation-induced sensitization of stainless steels; Berkeley, UK (23 Sep 1986).

Four austenitic steels having a constant major element composition of 12 Cr, 15 Ni and silicon in the range 0.14 to 1.42% have been irradiated with neutrons to doses of approx. 20 dpa at eight temperatures in the range 400°-645°C. The present paper describes the effect of irradiation temperature and silicon content on the compositional redistribution and very complex phase transformations which occur in these alloys.

21994 (INIS-GB—90, pp 135-140) **Discussion.** 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE87752852/JAW. (CONF-8609307—).

From Symposium on radiation-induced sensitization of stainless steels; Berkeley, UK (23 Sep 1986).

The paper is a discussion of the work presented at the symposium on "radiation-induced sensitisation of stainless steels", Berkeley, United Kingdom, 1986. The purpose of the symposium was to discuss the mechanism for inter-granular corrosion of 20%Cr/25%Ni/Nb stainless steel cladding of AGR fuel, following irradiation. The programme included contributions on the theory of radiation-induced segregation, on experimental studies by means of corrosion tests, on the analytical electron microscopy to measure compositional profiles at grain boundaries and on observations of such profiles in neutron, heavy ion and electron irradiated steels. (U.K.)

21995 **(INIS-mf—11623) States of light positive particles in metals.** Klamt, A.G. (Stuttgart Univ. (Germany, F.R.). Fakultaet 12 - Physik). 16 Feb 1987. 106p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number TI88752474/JAW.

The states of light positively charged particles in metals are treated in tight-binding approximation. The polaron states of the particles are investigated. The 'molecular crystal model' and an interstitial model' are treated. Moreover, the particle-lattice coupling of excited particles is treated for fcc and bcc lattices. (BHO).

21996 (INIS-SU—433, pp 53-54) **Kinetic evolution theory for disperse systems and new method of chemical reaction constants determination in multicomponent solid solutions.** Slezov, V.V.; Sagalovich, V.V. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1987. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780050/JAW.

Voprosy Atomnoj Nauki i Tekhniki.; no. 1(39).

In Radiation damage physics and science of materials.

Constructed with the authors theory of diffusion decomposition of multicomponent solid solutions at the latest stage condi-

tioned with diffusion interaction of macrodefects shows that nonlinear decomposition kinetics determines extremely peculiar behaviour of disperse systems - any system asymptotically in time "forgets" its initial state and passes into a stable state unique in corresponding variables. This permits to form fundamentally a new approach to the problem of experimental determination of important parameters of multicomponent systems - constants of equilibrium K/sub ∞// sup s/ for chemical reactions which proceed inside a solid body, coefficients of interphase energy σ/sup s/ and partial diffusion coefficients D/sub i/. For their determination the evolution in time of theoretical functions of phase particle distribution in sizes should be compared their central momenta and other characteristics depending on their parameters with corresponding experimental values which can be performed by a computer with a necessary accuracy. 4 refs.

21997 (INIS-SU—433, pp 30-34) **Study of radiation effects in amorphous boron containing iron base alloys.** Naskidashvili, I.A.; Martkoplishvili, G.S.; Serebryakov, A.V. (AN Gruzinskoj SSR, Tbilisi. Inst. Fiziki; AN SSSR, Chernogolovka. Inst. Fiziki Tverdogo Tela). 1987. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780050/JAW.

Voprosy Atomnoj Nauki i Tekhniki.; no. 1(39).
In Radiation damage physics and science of materials.

Method for measuring electric resistance was used to investigate the nature of radiation defect accumulation and reactor irradiation effect on the crystallization process of amorphous alloys of the following systems: Fe-B, Fe-B-P, Fe-B-Si. It is shown that main contribution to the radiation defect formation under irradiation of amorphous alloys mentioned with a neutron reactor spectrum is made with boron nucleus fission products. It is assumed that the crystallization temperature shift to either side on temperature scale change of its rate and temperature range depend not only on the nature and degree of radiation damages but also on the nature of defect distribution spectrum change in sizes. 6 refs.; 4 figs.

21998 (INIS-SU—433, pp 35-39) **Radiation coalescence theory of pore ensemble in material under irradiation.** Dubinko, V.I.; Ostapchuk, P.N.; Slezov, V.V. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1987. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780050/JAW.

Voprosy Atomnoj Nauki i Tekhniki.; no. 1(39).
In Radiation damage physics and science of materials.

A new physical process- "radiation coalescence" - resulting in radiation-stimulated growth of large pores at the expense of solution of smaller ones is suggested. Physical cause of "radiation coalescence" is the preference of pores to the absorption of interstitials produced under irradiation as compared with vacancies which is inversely proportional to pore radius. "Radiation coalescence" rate under typical irradiation conditions exceeds the rate of known "thermal coalescence" by several orders. It is shown that "radiation coalescence" limits maximum density of growing pores up to a value determined only with a dislocation structure and material constants. When exceeding this value "extra" pores dissolve quickly, which permits to calculate pore density at the latest irradiation stage not using the nucleation theory. Theoretical results agree well with experimental data comparison with which was performed without fitting parameters. 8 refs.; 2 figs.

21999 (INIS-SU—433, pp 40-47) **Void ordering mechanism in materials under irradiation.** Dubinko, V.I.; Tur, A.V.; Turkin, A.A.; Yankovskij, V.V. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1987. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780050/JAW.

Voprosy Atomnoj Nauki i Tekhniki.; no. 1(39).
In Radiation damage physics and science of materials.

It is shown that elastic attraction betwee voids and interstitial dislocation loops may result in loop absorption with voids along their slip directions. In consequence of this the effective attraction appears between voids along loop slip directions which together with isotropic diffusion repulsion leads to the formation of "bound" locally ordered states of voids growing due to the disordered void dissolution. Main properties of void lattice arising according to the mechanism suggested coincide with experimentally observed ones. 11 refs.; 3 figs.

22000 (INIS-SU—433, pp 60-64) **Metastable HCC intermetallics: theory and observation.** Akhiezer, I.A.; Davydov, L.N.; Matvienko, B.V.; Neklyudov, I.M.; Chernyaeva, T.P. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1987. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780050/JAW.

Voprosy Atomnoj Nauki i Tekhniki.; no. 1(39).
In Radiation damage physics and science of materials.

Problem of aggregate state of substance formed on ageing or low-temperature annealing of metal glass compositionally coinciding with intermetallic compound (i.e. during processes accompanied with liquidation of the nearest short-range position disorder when preserving the short-range compositional and topological orderin the frozen form). The presence of trend to the bcc crystal formation has been established theoretically even if the hcc phase of the substance under consideration is metastable (but not stable absolutely). The trend to the hcc crystal formation has been discovered experimentally on deformed titanium nickelide irradiated with Cr/sup 3+/ ions (3 MeV) at room temperature in which the given treatment types cause intense dispersion and amorphization. 3 refs.; 3 figs.

22001 (INIS-SU—433, pp 94-96) **Comparison of radiation-induced helium blistering on thin films and bulk nickel specimens.** Bendikov, V.I.; Neklyudov, I.M.; Rybalko, V.F.; Tal'yanskaya, O.Ya. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1987. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780050/JAW.

Voprosy Atomnoj Nauki i Tekhniki.; no. 1(39).
In Radiation damage physics and science of materials.

To compare helium blistering appearance on thin monocrystalline films and bulk nickel specimens, both specimen types were irradiated by He/sup +/ ions with 10 keV energy and current density of about 8 μA/cm at room temperature. It is found that on the films and bulk specimens blisters appear approximately at the same dose of about 5.5 x 10/sup 17/ cm/sup -2/. In case of films blisters have an average diameter (0.31 +- 0.05) μm and density (1.92 +- 0.2) x 10/sup 8/ cm/sup -2/ and an average diameter and density of blisters for bulk nickel constitute (0.33 +- 0.08) μm and (1.76 +- 0.2) x 10/sup 8/ cm/sup -2/, accordingly. Conclusion of identity of the final stage of helium porosity development in the films and bulk materials, on which basisan assumption is said, that processes in the films and bulk specimens preceding the final stage of helium porosity development must proceed in the sae manner, has been drawn. In connection with this the conclusion of the possibility of thin film usage for investigating physical nature of phenomena related to helium porosity development and representation of results obtained during such investigations for the bulk material has been drawn as well. 4 refs.; 2 figs.

22002 (INIS-SU—433, pp 97-100) **Self-sputtering under ion deposition condition and its influence on niobium film properties.** Belevskij, V.P.; Gusev, I.V. 1987. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780050/JAW.

Voprosy Atomnoj Nauki i Tekhniki.; no. 1(39).
In Radiation damage physics and science of materials.

Niobium film cathode sputtering under conditions of vacuum condensation with simultaneous bombardment by Nb/sup +/ ions at energy E/sub i/=(1.6-6.4)x10/sup -16/ J have been investigated. Calculation of experimental values of a sputtering coefficient S/sub Nb/ was performed from film thickness change in the range of niobium ion beam action. Four-probe method was used to investigate in helium cryostates superconducting film properties, and film texture was determined by X-ray diffraction analysis methods. S/sub Nb/ increases from 1.1 to 3.1 with E/sub i/ growth. Sequence of S/sub Nb/ increase is an abrupt decrease of effective deposition rate V/sub eff/. At niobium deposition with V/sub eff/ <or approx. V/sub PHI/, where V/sub D/-motion rate of quasidiffusion impurity boundary from a substrate, texture formation suppression and deterioration of superthin film superconducting properties (~ 10 nm) are observed which is sequence of ion mixing of film and substrate materials at the interface. The substrate it self is a main source of impurities in the film for such deposition conditions. 13 refs.; 4 figs.

22003 (INIS-SU—433, pp 101-108) **Ion bombardment effect on structure and electric properties of niobium films during deposition.** Belevskij, V.P.; Gusev, I.V. 1987. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780050/JAW.

Voprosy Atomnoj Nauki i Tekhniki.; no. 1(39).

In Radiation damage physics and science of materials.

Effect of bombardment by niobium ions with energy E/sub i/=(0.8-6.4)x10/sup -16/ J in the vacuum deposition process on structural characteristics (grain size, lattice parameter, texture, stresses and electrical properties specific electric resistance, superconducting transition temperature) of niobium films has been investigated. Set of energy parameters of ion deposition permitting to describe the effect of ion bombardment on a condensate has been determined. Critical process parameters: effective deposition rate V/sub eff/ and specific energy of ion bombardment PHI/sub E/, in different characteristic regions of which various regularities of ion irradiation effect on the film structure and physical properties are observed, have been found. Critical values of these parameters: ν/ sub eff/ $\sim$ ν/sub PHI/ and PHI/sub E/ $\sim$ 1 x 10/sup -17/ J/at. have been determined. Results of the investigations testify that in different ranges of PHI/sub E/ and ν/sub eff/ values different mechanisms of ion bombardment effect on a deposited film predominate: radiation-induced effects on the condensation surface, ion-stimulated annealing of films ion mixing at interface. 20 refs.; 7 figs.

22004 (INIS-SU—441, pp 59-61) **Some physico-chemical peculiarities of Li/sub 17/Pb/sub 83/ alloy.** Gromov, V.V.; Atanov, A.I.; Saunin, E.I.; Sorkin, M.Z. 1987. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88780051/JAW.

Voprosy Atomnoj Nauki i Tekhniki.; no. 1.

In Thermonuclear synthesis.

The process of gravitation liquation of Li/sub 17/Pb/sub 83/ was proposed and the experimental estimation of this phenomenon was done. The interaction of Li/sub 17/Pb/sub 83/ with air was studied by the thermal analysis, X-ray and ESCA techniques. The identification of interaction products was done and the scheme of possible chemical reactions was proposed.

22005 (INIS-SU—443, pp 3-8) **On polymorphous transformations in high-disperse polycrystalline structures.** Akhiezer, I.A.; Davydov, L.N.; Chernyaeva, T.P. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1987. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88780053/JAW.

Voprosy Atomnoj Nauki i Tekhniki.; no. 2.

In Physics of radiation damages and radiation science of materials.

Thermodynamics of low-temperature polymorphous transformations (occurring at temperatures much lower the melting point) is studied. The fact that the area of intergranular boundaries is conserved at such transformations has been taken into account. Theoretical expressions for the dependence of transition temperatures on the degree of material dispersivity have been found. It is shoun that the transformation temperature should decrease in high-dispersivity samples when dispersivity increasing, and the transformation range should extend. Experiments on indirect (on the basis of electrical resistance measurement) and direct electron microscopic observation of the martensitic transformation in high-dispersivity TiNi are described. The experimental results agree with the theory conclusions.

22006 (INIS-SU—443, pp 83-87) **Oscillating character of property-composition dependence for metallic solid solutions.** Andronov, V.M.; Ivanov, I.G.; Sirenko, A.F. (Khar'kovskij Gosudarstvennyj Univ., Ukrainian SSR). 1987. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88780053/JAW.

Voprosy Atomnoj Nauki i Tekhniki.; no. 2.

In Physics of radiation damages and radiation science of materials.

Oscillations of concentration dependence of some physical properties has been experimentally detected using binary metal solutions (Fe-Ni, Cu-Gd, In-Sn, etc.) in the single-phase region. The oscillating course of dependences "property-composition" is explained by change of one type of local atomic crystal groups by another one in conformity with the discrete character of their local composition.

22007 (INIS-SU—443, pp 20-26) **Influence of initial structure and stresses on accumulation kinetics for secondary radiation defects in vanadium epitaxial films.** Zubarev, E.N.; Koz'ma, A.A.; Stetsenko, A.N. (Khar'kovskij Pedagogicheskij Inst., Ukrainian SSR). 1987. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88780053/JAW.

Voprosy Atomnoj Nauki i Tekhniki.; no. 2.

In Physics of radiation damages and radiation science of materials.

Laws of secondary radiation defect and stress formation in vanadium epitaxial films irradiated by He/sup +/ ions differing by orientation, perfection of the crystal structure and elastic deformations acting there have been investigated by the methods of precision X-ray diffractometry, electron microscopy and electric resistance. Compressive defomations, ϵ $\sim$-0.4%, are generated in all films investigated under irradiation and then the process of secondary defect formation is suppressed. The effect relates to the strengthened recombination of interstitial atoms and vacancies in the defects of the dislocation type (introduction loops, edge dislocations). The initial growth of the lattice parameter a/sub 0/, in unstresses cross-section in perfect films makes available by small introduction loops, and its decrease in imperfect samples - by formation of helium-vacancy complexes, HeV. The further growth of a/sub 0/ is due to the recombination of the Frenkel pairs strengthened by compression and enrichment of He/sub m/V/sub n/(m>n) by helium.

22008 (INIS-SU—443, pp 29-34) **Comparison of void swelling under pulsed and continuous irradiation.** Koptelov, Eh.A.; Korolev, V.V. (AN SSSR, Moscow. Inst. Yadernykh Issledovanij). 1987. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88780053/JAW.

Voprosy Atomnoj Nauki i Tekhniki.; no. 2.

In Physics of radiation damages and radiation science of materials.

As a result of approximate analytical consideration and exact numerical calculation, a criterion of differences in velocity of vacancy void growth under pulsed and continuous irradiation, which is equivalent by mean velocity of defect generation. It includes simulteneously two conditions: 1) vacancy life-time is essentially lower than the irradiation period; 2) recombination of point defects under pulse irradiation predominates over defect drift to sinks. It is possible to follow simultinuously these conditions at temperatures being higher than the upper temperature of a swelling boundary, when stainless steel being irradiated under the conditions investigated (mean proton current - 500 μA, frequency - 100 Hz, on-off time ratio - 100). The numerical calculations show that the temperature pulses with <or approx. 100 deg amplitude under the given condition have not practically any effect on the velocity of vacancy void growth.

22009 (INIS-SU—443, pp 42-52) **Radiation-induced polymorphous transformations in metals.** Bakaj, A.S.; Kvachantiradze, G.G. 1987. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88780053/JAW.

Voprosy Atomnoj Nauki i Tekhniki.; no. 2.

In Physics of radiation damages and radiation science of materials.

The possibility of formation of polymorphic modifications when alloying metals by ions is considered. Energies of interphase boundaries and energies of elastic stress fields are determined in the approximation of pair model potentials of atom interaction. The possibility of induced polymorphic transformations of metals in the presence of finely divided carbide nuclei in the system is shown. Critical carbon concentrations necessary for realization of polymorphic transformations occuring in Nb are found. The theoretical diagram of determination of the conditions for transformations abovementioned is developed.

22010 (INIS-SU—443, pp 77-79) **Helium effect on high temperature ductility of molybdenum and niobium.** Ibragimov, Sh.Sh.; Reutov, V.F.; Zhdan, G.D. (AN Kazakhskoj SSR, Alma-Ata. Inst. Yadernoj Fiziki). 1987. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88780053/JAW.

Voprosy Atomnoj Nauki i Tekhniki.; no. 2.

In Physics of radiation damages and radiation science of materials.

Helium effect on molybdenum and niobium ductility and strength in the test temperature range from 600 to 1200 deg C has been studied. It is shown that molybdenum alloying with helium up to 1.2 x 10/sup -3/ at% concentration increases its strength and decreases ductility in the whole test temperature range. Helium effect in niobium develops only in ductility decreasing at 1200 deg C test temperature. Electron microscopic investigations show the presence of helium voids neither in molybdenum nor in niobium in the whole test temperature range.

22011 (JINR—R-7-86-322, pp 86) **Yield strength change of nickel resulted from energetic heavy ion irradiation.** Khavanchak, K.; Skuratov, V.A.; Senesh, D. 1986. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780065/JAW.

In Heavy ion physics - 1985. Collection of annotations of the Nuclear Reaction Laboratory of the Joint Nuclear Research Institute works, 1985.

22012 (KFTI—87-23) **Effects of irradiation on thermal coalescence of pores in real crystals.** Dubinko, V.I.; Ostapchuk, P.N.; Slezov, V.V. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1987. 11p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701683/JAW.

Thermal coalescence of pores in crystals under irradiation with the general suppositions on evolution of the dislocation structure, described in frames of phenomenological mode, is studied. A new thermal coalescence mode - recombination mode, is found. From comparison with the experiment it is stated that thermal coalescence is responsible for the decrease of the pore density with the temperature growth, that in recombination mode proceeds without change of the swelling rate. 9 refs.; 2 figs.

22013 (LBL—23972) **Modeling the behavior of oriented permanent magnet material using current double theory.** Green, M.A. (Lawrence Berkeley Lab., CA (USA)). Nov 1987. Contract AC03-76SF00098. 6p. (CONF-870901—28). NTIS, PC A02. Order Number DE88004446/JAW.

From 10. international conference on magnet technology (MT-10); Boston, MA, USA (21 Sep 1987).

This paper presents a method for modeling two dimensional dipoles, quadrupoles and other higher multipoles built using oriented permanent magnet materials such as samarium cobalt (one of the rare earth cobalt REC materials). The technique presented here uses complex current doublet to model the magnetized material. This technique can be used in conjunction with an infinitely permeable circular iron shield which lies outside the REC material. Examples of two types of dipoles and quadrupoles are presented in this report. 15 refs., 4 figs., 1 tab.

22014 (LBL—24387) **Magnetic and structural characterization of Nd-Fe-B sintered permanent magnets.** Chen, Jimmy Kuo-Wei. (Lawrence Berkeley Lab., CA (USA)). Dec 1987. Contract AC03-76SF00098. 71p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88006327/JAW.

Magnetic, structural, and chemical characterization using a hysterisigraph, transmission electron microscope, scanning electron microscope, and x-ray diffractometer were carried out on sintered Nd-Fe-B permanent magnets of nominal composition $Nd_{14}Fe_{78}B_8$. Applying a maximum field of 23 kOe, the following magnetic properties were measured: B/sub r/ = 11.37 kG, H/sub c/ = 9.62 kOe, /sub i/H/sub c/ = 12.19 kOe, and (BH)/sub max/ = 28.83 MGOe. BH loop studies suggested that these magnets were "nucleation-controlled" magnets, which reversed their magnetization by the nucleation and growth of reverse magnetic domains. This conclusion was supported by microstructural studies, which revealed the presence of domain walls within the grains. The general microstructure was found to consist of defect free grains about 5 μm in diameter of the hard magnetic matrix phase $Nd_2Fe_{14}B$, surrounded by a highly defective Nd-rich fcc grain boundary phase with lattice parameter ≅5.6 A. This grain boundary phase also contained significant amounts of oxygen, some dissolved iron, and no boron. Small amounts of a third highly defective boride phase with lattice parameters a ≅ 7.6 A and Δc ≅ 30.5 A was also observed. A fourth phase, a bcc surface phase with lattice parameter a ≅ 2.9 A was determined to be an artifact of ion milling. The compatibility of this microstructure with a nucleation-controlled magnet is discussed, along with some processing suggestions for improving the magnetic properties through microstructural design. 20 refs., 34 figs., 4 tabs.

22015 (LBL—24443) **An investigation of the influence of dislocation substructures on the deformation behavior of AK, DQ steel sheets.** Vincent, S.A. (Lawrence Berkeley Lab., CA (USA)). Dec 1987. Contract AC03-76SF00098. 69p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88006337/JAW.

Purpose of this study was to observe the effect of dislocation substructure on the deformation behavior of low carbon steel sheet, and to search this information for clues about the effects of these substructures on work hardening behavior. The method included first developing different types of substructures in otherwise identical specimens by prestraining at different temperatures. These specimens were then subjected to continued deformation at the same temperature. The tensile behavior was then analyzed, bearing in mind the substructural changes, in an effort ot improve the fundamental understanding of the deformation process. 17 figs.

22016 (MINTEK-M—307) **Phase relations in the system nickel-copper-sulphur-ruthenium at 1200/sup 0/C.** Nell, J. (Council for Mineral Technology, Randburg (South Africa). Mineralogy Div.). (Council for Mineral Technology, Randburg (South Africa)). 31 Mar 1987. 12p. NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701770/JAW.

Dry sulphide experiments in the system copper-nickel-sulphur-ruthenium were carried out at 1200/sup 0/C in an investigation of the influence of ruthenium on the slow cooling of a UG-2-type matte. Laurite(RuS/sub 2/), ruthenium metal, and two ruthenium-nickel alloys were found to be the only ruthenium-bearing phases that are stable under the experimental conditions. The resulting phase diagram indicates that a ruthenium-rich ruthenium-nickel alloy will co-exist with a sulphide liquid during the slow cooling of a ruthenium-rich UG-2-type matte.

22017 (ORNL/Sub—81-07685/02-77) **Transformation, metallurgical response and behavior of the weld fusion zone and heat affected zone in Cr-Mo steels for fossil energy application: Final technical report for January 1985-September 1987.** Lundin, C.D.; Henning, J.A.; Menon, R.; Khan, K.K. (Tennessee Univ., Knoxville (USA). Welding Research and Engineering). 30 Sep 1987. Contract AC05-84OR21400. 260p. NTIS, PC A12/MF A01; 1; GPO Dep. Order Number DE88006037/JAW.

This research program was undertaken to provide fundamental and basic metallurgical information on the behavior of the heat affected zone (HAZ) in Cr-Mo steel welds as well as practical information on their relative weldability. The principal work was the evaluation of the post weld heat treatment (PWHT) cracking of Cr-Mo steels ranging in Cr content from 2-1/4% to 9%. Differences in observed cracking behavior were contrasted with composition, on cooling transformation behavior and HAZ microstructure. Hydrogen assisted cracking (HAC) studies using a large scale cracking test were conducted on 2-1/4 Cr and 3 Cr steels. Soft zone studies were conducted on 9 Cr NKK steel to determine the reason for the development of a low hardness region ("Soft Zone") at the outer boundary of the HAZ. The literature review provides a concise historical review and the basis of theories for PWHT cracking and HAC in Cr-Mo steels which were employed to explain the weld cracking susceptibility of various Cr-Mo alloys. PWHT cracking susceptibility was investigated using Gleeble simulated heat affected zone (HAZ) specimens. A new test was developed at the University of Tennessee, The C-ring test, to evaluate the PWHT cracking

behavior. The C-ring test was found to be an extremely useful test for PWHT cracking susceptibility and for verifying the results obtained from Gleeble tsting. An excellent correlation was obtained for the two tests. The standard Y-groove test was selected for HAC susceptibility testing. This test is very suitable for evaluating the HAC of the base metal and is defined in Japanese Industrial Standard JIS Z 3158.

22018 **(PB—88-143847/XAB) Development of Laves-Phase (C15) vanadium-zirconium-hafnium superconductor for high-field superconducting magnet use.** Hazelton, D.W. (Intermagnetics General Corp., Guilderland, NY (USA)). Feb 1986. 38p. NTIS, PC A03/MF A01.

The project examined several processing methods by which V_3(Hf-Zr) Laves-phase superconductor could be fabricated including hot extrusion of billets containing V, Hf, Zr components of either powder or foil form incorporated with stabilizing Cu protected by a Nb diffusion barrier. Cold processed billets of similar composition were also investigated. These materials were then drawn with intermediate anneals down to wire (0.012-0.064 inch diameters) with varying degrees of difficulty. Wire samples were then heated to form the Laves Phase material via interdiffusion of the V, Hf, and Zr components. Scanning electron microscope (SEM) examinations were conducted on various samples and critical-current densities measured. Results are given in the report.

22019 **(PB—88-157722/XAB) Institute for materials science and engineering, metallurgy: technical activities 1987. Annual report.** (National Bureau of Standards, Washington, DC (USA)). Oct 1987. 106p. (NBSIR—87/3615). NTIS, PC A06/MF A01.

See also PB—87-136685.

This report summarizes the FY 1987 activities of the Metallurgy Division of the National Bureau of Standards. The research centers upon the structure-processing-properties relations of metals and includes alloys and on the methods of their measurement. The activities also include the generation and evaluation of critical materials data. Efforts comprise studies of metallurgical processing, corrosion and wear, chemical metallurgy, electrodeposition, nondestructive characterization and magnetic materials. The work described also includes three cooperative programs with American professional societies and industry: the American Society for Metals (ASM) - NBS Alloy Phase Diagram Program, the National Association of Corrosion Engineers (NACE) - NBS Corrosion Data Program, the American Iron and Steel Institute (AISI) - NBS Steel Sensor Program, and the Aluminum Association. Work in support of other government agencies includes a major program to assist the Nuclear Regulatory Commission in addressing the critical national problem of disposing of high level nuclear waste in geologic repositories.

22020 **(PINSTECH/NMD—116) Intergranular corrosion of Incoloy 800 by electrochemical potentiokinetic reactivation and huey test methods.** Rahman, S.; Hussain, N.; Shahid, K.A. (Pakistan Inst. of Nuclear Science and Technology, Islamabad. Nuclear Materials Div.). Mar 1986. 19p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701221/JAW.

To measure the degree of sensitization (DOS) quantitatively in stainless steels an Electrochemical Potentiokinetic Reactivation (EPR) method was developed. Here in this report the reliability and reproducibility of this technique was studied. The test was also extended to quantify the DOS in Incoloy-800 and efforts made to correlate it with ASTM A 262-Practice C; Huey Test. The investigation as performed by annealing the specimens at different temperatures around and within the sensitization range of material and testing by both the methods. The results measured by potentiokinetic reactivation method and the Huey test were not in correspondence with each other. The reproducibility of EPR method was found to be good.

22021 **(PINSTECH/NPD—121) Segregation effects in welded stainless steels.** Akhter, J.I.; Shoaid, K.A.; Ahmed, M.; Malik, A.Q. (Pakistan Inst. of Nuclear Science and Technology, Islamabad. Nuclear Physics Div.). 1987. 16p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701224/JAW.

Welding of steels causes changes in the microstructure and chemical composition which could adversely affect the mechanical and corrosion properties. The report describes the experimental results of an investigation of segregation effects in welded austenitic stainless steels of AISI type 304, 304L, 316 and 316L using the techniques of scanning electron microscopy and electron probe microanalysis. Considerable enhancement of chromium and carbon has been observed in certain well-defined zones on the parent metal and on composition, particularly in the parent metal, in attributed to the formation of (M/sub 23/C/sub 6/) precipitates. The formation of geometrically well-defined segregation zones is explained on the basis of the time-temperature-precipitation curve of (M/sub 23/C/sub 6/).

22022 **(SAND—87-0988C) Finite element simulation of perforation of aluminum plates.** Chen, E.P. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 10p. (CONF-880438—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002092/JAW.

From International conference on computational engineering science; Atlanta, GA, USA (10 Apr 1988).

Perforation of aluminum plates by steel penetrators is the subject of discussion in the present investigation. Specifically, laboratory scale experiments were simulated using the transient dynamic finite element code PRONTO 2D. For the range of impact velocities considered in this study, the penetrator experiences little deformation while the target exhibits ductile hole-growth behavior. Thus, both the penetrator and the target are taken as elastic/plastic hardening materials in the finite element model. Detailed numerical treatement of the perforation process is discussed. Comparison between calculated results and experimental data show good agreements. 6 refs., 8 figs., 3 tabs.

22023 **(SAND—87-1196C) Effect of P implantation on the corrosion behavior of Fe-Cr alloys.** Sorensen, N.R.; Diegle, R.B.; Picraux, S.T.; Nelson, G.C. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 13p. (CONF-871027—45). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005732/JAW.

From 172. meeting of the Electrochemical Society; Honolulu, HI, USA (18 Oct 1987).

We are using ion implantation to study the corrosion/passivation behavior of glassy metals. The implantation process allows us to alter both the structure and composition of the surface. We are investigating P implantation (100 keV) into Fe-Cr alloys at fluences ranging from 2.3×10^{16} to 2.5×10^{17} P/cm^2, which induces a crystalline to amorphous structural transition. We are studying the passivation of implanted and unimplanted Fe-Cr alloys in 0.1N H_2SO_4 with small (0 to 500 ppM) additions of NaCl. At low Cr (6 at. %) concentrations, P implantation improves passivity at applied passive potentials in the Cl-free electrolyte, but it induces pitting when chlorides are present. The improvement in passivity is manifested as an increase in the passivation rate and an increase in the quality of the film, which resists breakdown by Cl ions if they are added after the equilibrium passive film is established. At high Cr concentrations (18 at. %) there is little benefit of implanting P because the base alloy is able to form a protective film by virtue of the high Cr content. At intermediate Cr concentrations, P implantation to produce an amorphous surface results in a decrease in current density of four orders of magnitude. For an Fe-10Cr alloy, increasing the P concentration causes a progressive change in corrosion morphology from general attack, through pitting, to passivation. During general attack the corrosion film is unprotective and permits uniform corrosion. In the P range where pitting is observed, a three-dimensional oxide film is present that thickens when passivity is observed. 4 refs., 7 figs.

22024 **(UCRL—96370) Directed-energy electron-beam processing of a hypoeutectic $Cr_{90}Ta_{10}$ alloy.** Huang, J.S.; Kaufmann, E.N. (Lawrence Livermore National Lab., CA (USA)). Sep 1987. Contract W-7405-ENG-48. 13p. (CONF-8710288—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005621/JAW.

From Meeting on solidification processing of eutectic alloys; Cincinnati, OH, USA (10 Oct 1987).

A hypoeutectic $Cr_{90}Ta_{10}$ alloy was processed using a directed-energy electron-beam surface melting and resolidification technique to study its microstructure evolution during rapid solidification. The power of the electron beam was 2500 W and the scan speed ranged from 0.13 to 2.0 m/sec. Microstructure characteristics such as transitions from planar front to dendritic growth, and from cellular to dendritic growth were observed. At low solidification rate, the interdendritic regions are characterized by the Cr/Cr_2Ta eutectic, and at high solidification rate the intercellular regions are characterized by a Cr_2Ta phase. For the latter, the distribution of Ta-solute across the interior of a cell is very uniform. In a given sample, the primary cell spacing increases as the solidification front moves from the substrate/regrowth interface toward the surface. The solidification parameters, i.e., temperature gradient and growth velocity, were determined with finite-element heat flow analyses. The observed microstructure characteristics were correlated to these parameters using available theoretical models. 9 refs., 11 figs., 1 tab.

22025 **(UCRL—96473) Use of the LLNL 40 kV electric gun to study the shock response of 21-6-9 stainless steel.** Brusso, J.A.; Mikkola, D.E.; Bloom, G.; Lee, R.S.; Von Holle, W. (Lawrence Livermore National Lab., CA (USA); Michigan Technological Univ., Houghton (USA)). 15 Jul 1987. Contract W-7405-ENG-48. 8p. (CONF-870753—72). NTIS, PC A02. Order Number DE87014550/JAW.

From 5. topical conference of the American Physical Society on shockwaves in condensed matter; Monterey, CA, USA (20 Jul 1987).

Exploding foil-flyer plate ("electric gun") methods have been used to shock 21-6-9 stainless steel over a wide range of shock pulse amplitudes (20 to 53 GPa) and durations (10 to 70 ns). Dislocation generation and twinning have been studied in recovered specimens with the results providing support for the concept of finite rate plastic processes. 24 refs., 6 figs., 1 tab.

22026 **Tight-binding calculation of Ti-Rh—type phase diagram.** Sluiter, M.; Turchi, P.; Fu Zezhong; de Fontaine, D. (Department of Materials Science and Mineral Engineering, University of California, Berkeley, California 94720). *Physical Review Letters;* **60**: No. 8, 716-719(22 Feb 1988).

Tight-binding electronic band-structure calculations were combined with a free-energy expression from a statistical mechanical method called the cluster-variation method. The effective pair interactions used in the cluster-variation calculation were evaluated by the generalized perturbation method. Only d orbitals were included and the numbers of d electrons per atom were taken to be three for the pure A element and eight for the pure B. A phase diagram was constructed incorporating, for the first time, both fcc and bcc lattices and their simple-ordered superstructures. The calculated diagram agreed reasonably well with those determined empirically for Ti-Rh or Ti-Ir.

22027 **Electronic structure and geometries of heteroatomic clusters.** Rao, B.K.; Jena, P. (Physics Department, Virginia Commonwealth University, Richmond, Virginia 23284-2000). *Physical Review* [*Section*] *B: Condensed Matter;* **37**: No. 6, 2867-2873(15 Feb 1988).

The equilibrium geometries and the electronic structure of heteroatomic clusters involving alkali-metal-atom hosts and aluminum and magnesium impurity atoms have been studied using the self-consistent-field linear combination of atomic orbitals—molecular orbital method. The total energies of the clusters have been calculated by including exchange interaction within the unrestricted Hartree-Fock approximation and the correlation contribution within using the configuration interaction involving the double excitations of the valence electrons. The heteroatoms are found to have significant effect on the topology of the host clusters. The relative stabilities and ionization potentials of heteroatomic clusters exhibit odd-even alternation in agreement with experimental data. The evolution of the binding energies of the heteroatom with cluster size testifies to the delocalized nature of the electrons of the host cluster. While the energy gained in adding an additional alkali-metal atom to the existing heteroatomic cluster continues to oscillate with cluster size, the heteroatom binding energy varies monotonically.

22028 **Empirical band calculations of the optical properties of d-band metals. VI. The optical conductivity of ferromagnetic iron.** Sexton, J.H.; Lynch, D.W.; Benbow, R.L.; Smith, N.V. (Department of Physics and Ames Laboratory, Iowa State University, Ames, Iowa 50010). *Physical Review* [*Section*] *B: Condensed Matter;* **37**: No. 6, 2879-2883(15 Feb 1988).

The optical conductivity of ferromagnetic Fe was calculated with an interpolation scheme fit to first-principles energy bands for paramagnetic Fe with a constant exchange splitting. Most of the contributions to the conductivity originate in the minority-spin bands, making the rigid splitting a valid assumption. The inclusion of electric-dipole matrix elements is essential for obtaining agreement with experiment. The locations of the transitions in the band structure were found by plotting contributions from differential volumes throughout the irreducible wedge of the Brillouin zone, including dipole matrix elements. The strong transitions around 2.5 eV occur between flat bands in large regions of the zone, regions not associated with symmetry points, lines, or planes. The transitions near 6 eV originate in a smaller volume of k space near a symmetry line, associated with an interband critical point.

22029 **Theory of antiferromagnetic correlations and neutron-scattering cross section in heavy-fermion metals.** Auerbach, A.; Kim, J.H.; Levin, K.; Norman, M.R. (The University of Chicago, James Franck Institute, Chicago, Illinois 60637). *Physical Review Letters;* **60**: No. 7, 623-626(15 Feb 1988).

We show that antiferromagnetic correlations with frequencies scaling as the inverse-mass enhancement are universal features of coherent heavy fermions. The associated neutron cross-section peaks may be either quasielastic or inelastic. Spin-orbit and crystal-field interactions yield zone-center peaks at comparable frequencies. This experimentally observed behavior is derived from a 1/N expansion. Because these correlations are not "soft" and are general features of hybridized band structure, they do not necessarily elucidate the superconducting mechanism.

22030 **Optical constants for thin films of Ti, Zr, Nb, Mo, Ru, Rh, Pd, Ag, Hf, Ta, W, Re, Ir, Os, Pt, and Au from 24 A to 1216 A.** Windt, D.L.; Cash W.C. Jr.; Scott, M.; Arendt, P.; Newnam, B.; Fisher, R.F.; Swartzlander, A.B. (University of Colorado, Center for Astrophysics & Space Astronomy, Boulder, Colorado 80309). *Applied Optics;* **27**: No. 2, 246-278(15 Jan 1988).

Reflectance vs incidence angle measurements have been performed from 24 A to 1216 A on electron-beam evaporated samples of Ti, Zr, Nb, Mo, Ru, Rh, Pd, Ag, Hf, Ta, W, Re, Ir, Os, Pt, and Au, and using a nonlinear least-squares curve-fitting technique, the optical constants have been determined. Independently measured values of the incident beam polarization, film thicknesses, and film surface roughnesses are incorporated into the derivation of the optical constants. Additionally, Auger electron spectroscopy depth profiling measurements have been performed on each sample to characterize sample composition including oxidation and contamination.

22031 **Use of Tribocor 532N for a carbon-free induction furnace for vacuum-induction melting and casting of uranium and its alloys.** Holcombe, C.E. Jr.; Reiner, R.H.; Dykes, N.L. (Oak Ridge Y-12 Plant, TN, USA). *Journal of Materials Science Letters;* **6**: No. 11, 1353-1355(Nov 1987). Contract AC05-84OR21400.

The paper concerns the development of a carbon-free induction furnace for vacuum-induction melting and casting of uranium and its alloys. Tribocor 532N - an alloy of 50% niobium, 30% titanium and 20% tungsten, was used to make a test crucible, which was tested for over 20 runs in a development-scale casting furnace. The results showed that Tribocor 532N is an excellent crucible/susceptor, that exhibits high levels of stability with uranium and its alloys.

22032 Influence of hydrogen on deformation and fracture processes in high-strength aluminum alloys. Bond, G.M.; Robertson, I.M.; Birnbaum, H.K. (Univ. of Illinois, Dept. of Metallurgy and Mining Engineering and Materials Research Lab., Urbana, IL 61801). *Acta Metallurgica;* **35**: No. 9, 2289-2296(Sep 1987). Contract AC02-76ER01198.

Hydrogen-enhanced fracture of age hardened 7050 and 7075 alloys has been studied by an in situ environmental cell TEM deformation technique. The effects of both gaseous and solute hydrogen were investigated. The effects of high-fugacity gaseous hydrogen atmospheres on the behavior of dislocations and crack tips in these alloys were monitored by video recording of dynamic events. It is concluded that hydrogen enhances dislocation mobility and reduces the flow stress. Fracture in hydrogen was similar to that observed in vacuum except that it occurred at lower stresses due to hydrogen-enhanced dislocation mobility. Large silicon- and iron-rich precipitates influenced cracking in cathodically precharged specimens as a result of hydrogen accumulation in their vicinity.

22033 Effects of pre-existing grain boundary microvoid distributions on fracture toughness and fatigue crack growth in low alloy steel. Dauskardt, R.H.; Pendse, R.D.; Ritchie, R.O. (Dept. of Materials Science and Mineral Engineering, Univ. of California, Berkeley, CA 94720). *Acta Metallurgica;* **35**: No. 9, 2227-2242(Sep 1987).

The role of dispersions of pre-existing grain boundary microvoids is investigated in fracture toughness and fatigue crack propagation behavior in a low alloy steel. Microvoid damage was achieved by prior exposure to gaseous hydrogen atmospheres at high temperatures and pressures where carbon reacts with hydrogen to nucleate methane bubbles along prior austenite grain boundaries (hydrogen attack). Whereas the crack initiation and crack growth toughness (i.e. K/sub Ic/ and the tearing modulus) were degraded even for comparatively mild degrees of microvoid damage, rates of sub-critical crack growth by fatigue remained relatively unaffected. Such results are interpreted in terms of a mutual competition between microstructural damage generated by the grain boundary microvoids, which promotes crack growth by lowering the intrinsic resistance of the microstructure, and the resulting tortuous crack paths, which extrinsically retard crack growth at low stress intensities by lowering the local crack tip driving force (crack tip shielding). As shielding effects are minimized at high stress intensities, the degradation in intrinsic toughness is related to changes in ductility by means of a stress-modified critical strain model for ductile fracture where the presence of small microvoid clusters promotes coalescence through the easier onset of plastic strain localization. Fatigue behavior, conversely, is dominated by extrinsic shielding mechanisms and is modeled in terms of two-dimensional models of crack deflection and roughness-induced crack closure.

22034 Spinodal ordering beyond the Lifshitz point in Cu/sub 3/Pd observed by high voltage electron microscopy. Takeda, S.; Kulik, J. (Dept. of Physics, College of General Education, Osaka Univ., Toyonaka, Osaka 560). *Acta Metallurgica;* **35**: No. 9, 2243-2254(Sep 1987).

Cu-Pd samples of compositions varying from 16 to 26 at. % Pd were irradiated in situ in a 1.5 MeV electron microscope at various temperatures. Low temperature (-180°C) irradiation produced completely disordered solid solutions, room temperature irradiation produced steady state short range order (SRO), and high temperature irradiation tended to produce the expected equilibrium long range order. The 18 and 20% samples irradiated at room temperature exhibited steady state modulated SRO although only the simple Ll/sub 2/ ordered structure was expected at equilibrium. It is suggested that spinodal ordering is responsible for these effects. An f.c.c.-based Cu-Pd phase diagram is proposed incorporating ordering stability loci and a metastable Lifshitz point.

22035 Residual stress effects on fatigue crack growth behavior in stainless steel welds. Mills, W.J.; James, L.A. (Westinghouse Hanford Co., Richland, WA 99352). *Journal of Pressure Vessel Technology;* **109**: No. 3, 336-339(Aug 1987).

Standard fatigue precracking of fracture toughness specimens taken from stainless steel welds with a double-V design was found to result in extremely uneven crack fronts. Material variability within the weld zone could not explain the irregular crack fronts, which must therefore be associated with residual stress effects. Uniform fatigue cracks could be obtained by sectioning the double-V weld at the mid-thickness to relieve residual stresses and by precracking at a stress ratio of 0.4. Residual stresses can impact the leak-before-break position for welded structures.

22036 Experimental study on impact/fretting wear in heat exchanger tubes. Cha, J.H.; Wambsganss, M.W.; Jendrzejczyk, J.A. (Korea Advanced Energy Research Institute, Taejon). *Journal of Pressure Vessel Technology;* **109**: No. 3, 265-274(Aug 1987).

The objective of this study is to provide qualitative impact/fretting wear information for heat exchanger tubes through the performance of a series of tests involving the pertinent parameters: force between the tube and its support; tube to support plate hole clearance; tube support plate thickness; preload; and tube vibration frequency. The characteristics of impact/fretting wear relative to material combinations and fluid environment were also investigated. The test apparatus consists of a cantilevered tube with a simulated tube support plate at the "free end." Tube vibration is induced by an electromagnetic exciter to simulate the flow-induced tube motion occurring in a real heat exchanger at the tube/tube support plate interface. Tests are conducted in air, water, and oil, all at room temperature. Removable wear rings are attached to the tube free end and simulated support fixture. Wear ring materials include carbon steel, 304 stainless steel, Inconel 600 and brass. Wear is measured by a weight loss technique and wear rates are calculated and reported as functions of the various pertinent parameters. Based on the test results, general conclusions are drawn.

22037 Nondestructive evaluation of steels using acoustic and magnetic Barkhausen signals - II. Effect of intergranular impurity segregation. Kameda, J.; Ranjan, R. (Ames Lab., Iowa State Univ., Ames, IA 50011). *Acta Metallurgica;* **35**: No. 7, 1527-1532(Jul 1987). Contract W-7405-ENG-82.

The present paper has studied the influence of intergranular impurity segregation on acoustic and magnetic Barkhausen signals induced during magnetization of an undoped nickel-chromium steel and doped steels with antimony, tin or phosphorous. While the intergranular segregation did not affect the magnetic hysteresis loop, it caused the characteristics of the acoustic and magnetic signals to change in a different manner. The impurity-doped steels produced a higher magnitude of the acoustic signal than the undoped one. However, the acoustic signal intensity of the impurity-doped steels remained the same independent of the quantity and type of segregants. With increasing segregants, the magnitude of the magnetic signal initially decreased and then increased above 0.078 atomic fraction. The magnetic signal did not depend on the type of segregants. The effect of segregated impurities on the grain boundary energy and magnetostatic energy at grain boundaries which change the nucleation and growth processes of domains is discussed.

22038 Nondestructive evaluation of steels using acoustic and magnetic Barkhausen signals - I. Effect of carbide precipitation and hardness. Kameda, J.; Ranjan, R. (Ames Lab., Iowa State Univ., Ames, IA 50011). *Acta Metallurgica;* **35**: No. 7, 1515-1526(Jul 1987). Contract W-7405-ENG-82.

The effect of microstructures on acoustic and magnetic Barkhausen signals has been investigated in a quenched and tempered steel and spheroidized steels with various carbon contents. A major peak of the acoustic Barkhausen signal was induced when a magnetic field was increased from zero to the saturation state. A minor peak of the acoustic signal and a single peak of the magnetic signal appeared during the decreasing field. The peak value of the acoustic Barkhausen signal shows a linear dependence on the sweep rate of a magnetic field while that of the magnetic Barkhausen shows a nonlinear one. The increasing tempering temperature which gives rise to a decrease in hardness and an increase in carbide size and spacing caused the acoustic and magnetic Barkhausen peak voltages to increase precipitously and gradually, respectively. In the spheroidized steels, the acoustic peak voltage monotonically decreased with increasing carbon content from 0.17 to 0.96 wt% and the magnetic peak voltage was greatest when the carbon content was 0.46 wt%.

22039 In-situ straining of Ni/sub 3/Al in a transmission electron microscope. Baker, I.; Schulson, E.M.; Horton, J.A. (Thayer School of Engineering, Dartmouth College, Hanover, NH 03755). *Acta Metallurgica;* **35**: No. 7, 1533-1542(Jul 1987).

TEM in-situ straining experiments have been performed on thin foils of Ni/sub 3/Al and Ni/sub 3/Al containing 750 ppm (0.35 at.%) boron. During the straining, gliding APB-coupled dislocations were observed to leave superlattice intrinsic stacking faults (S-ISF's) as debris in their wake confirming a mechanism for S-ISF formation. The APB-coupled dislocations pile-up at grain boundaries, become extrinsic grain boundary dislocations and initiate slip in adjacent grains. The characteristics of the crack propagation process indicated that plastic flow, albeit localized, precedes fracture.

22040 Synergism between creep ductility and grain boundary bubbles. Shewmon, P. (Dept. of Metallurgical Engineering, Ohio State Univ., Columbus, OH 43210). *Acta Metallurgica;* **35**: No. 6, 1317-1324(Jun 1987).

The decrease in creep ductility that can be caused by internal pressure in grain boundary pores is modelled to treat the interaction between boundary diffusion, power law creep, and bubble pressure. The application to 2.25 Cr-1 Mo steel in high pressure hydrogen is treated numerically using a computer program. Reasonable agreement is obtained between the predictions and the observed loss in ductility in the presence of 21 MPa of hydrogen. With methane pressurized bubbles, the model suggests intergranular fracture is power law creep limited at essentially all temperatures and stresses. In the absence of hydrogen (methane), intergranular fracture should be limited by diffusion creep and thus more sensitive to pore density and boundary diffusion rate than strength. Possible application to recent high temperature steamline failures in welded pipe and helium effects in nuclear reactor materials are also indicated.

22041 Dynamic embrittlement of boron-doped Ni/sub 3/Al alloys at 600°C. Liu, C.T.; White, C.L. (Metals and Ceramics Div., Oak Ridge National Lab., Oak Ridge, TN 37831). *Acta Metallurgica;* **35**: No. 3, 643-650(Mar 1987). Contract AC05-84OR21400.

Boron-doped Ni/sub 3/Al alloys, with and without 0.5 at.% Hf, were tensile tested in vacuum and in oxidizing environments at 600°C. Tensile ductility was found to be strongly dependent on test environment, with much lower ductilities observed in air than in vacuum. The loss in ductility is accompanied by a change in fracture mode from transgranular to intergranular. The severity of this environmental effect on elevated-temperature ductility is also affected by preoxidation in air as well as by the aluminum content of the aluminide. Tests of preoxidized specimens indicate that the embrittlement is due to a dynamic effect simultaneously involving localized stress concentrations, elevated temperature, and gaseous oxygen. The oxygen embrittlement becomes less severe with a decrease in aluminum concentration from 24 to 21 at.%.

22042 Geometrical models for symmetrical tilt boundaries in L1/sub 2/ ordered compounds. Farkas, D.; Rangarajan, V. (Dept. of Materials Engineering, Virginia Polytechnic Institute and State Univ., Blacksburg, VA 24061). *Acta Metallurgica;* **35**: No. 2, 353-366(Feb 1987).

A modified hard sphere model and coincident site lattice theory were used to analyze the possible configurations of symmetrical tilt boundaries with the L1/sub 2/ structure. The minimum allowed interatomic distances used in the model were estimated from the structures of stable intermetallic phases in the corresponding binary system. Two different compounds were analyzed, Cu/sub 3/Au and Ni/sub 3/Al. For Cu/sub 3/Au, the grain boundary structures obtained were similar to those reported by other investigators for pure f.c.c. metals. Several boundaries were found to present two possible structures, differing in composition and ordering state. The contribution of disordering to the grain boundary energy was calculated in a point approximation based on the first coordination shell. For compounds of the Ni/sub 3/Al type the grain boundary structures that are most dense were found to be generally different from configuration of boundaries in pure f.c.c. metals and Cu/sub 3/Au. These configurations preserve order, but are less dense. The possibility of grain boundary "phases" that are not present in other f.c.c. materials may constitute an explanation for the extreme g.b. weakness observed in Ni/sub 3/Al and other L1/sub 2/ compounds with high ordering energy.

22043 Ion-induced growth of whiskers on Sn films. Poker, D.B.; Schubert, J.; Stritzker, B. (Oak Ridge National Lab., Oak Ridge, TN 37831). pp 529-534 of Beam-solid interactions and transient processes. Thompson, M.O.; Picraux, S.T.; Williams, J.S. Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—). Contract AC05-84OR21400.

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

Whiskers have been observed to form on thin films (1000-2000 A) of Sn following implantation of 20-keV H or He at temperatures below 150 K. The morphology of the whiskers following each growth was examined using scanning electron microscopy (SEM) to illuminate the possible growth modes. In an effort to obtain support for either of several models of the growth process, the region near the base of the whiskers was examined for evidence of depletion or extrusion. No evidence of depletion was observed. The whiskers could be classified into two types: those that were supported on pedestals, a short transition region at the base of the whisker; and those without pedestals, which rose abruptly from the film with no transition. A novel structure has been observed on Sn films that were coated with 500 A of Au/Pd to enhance the SEM image. The structure consists of a thin, planar surface several microns in length, oriented perpendicular to the substrate. The structures did not appear immediately after coating, but were present after storage in air for one month.

3602 Ceramics, Cermets, And Refractories

REFER ALSO TO CITATION(S) 21012, 22134, 22134, 22153, 22195, 22200, 22250

22044 (AD-A—186989/0/XAB) Wire-cut electrical discharge machinability of ceramics. Final report. Ricci, W.S.; Skeele, H.A.; Blumenthal, W.R. (Army Materials Research Agency, Watertown, MA (USA). Materials Technology Lab.). Sep 1987. 29p. (MTL-TR—87-52). NTIS, PC A03/MF A01.

The wire-cut electrical discharge machinability of four ceramics was evaluated. Titanium diboride and silicon carbide workpieces were successfully cut in the monolithic state. Boron carbide could only be cut when a metallic sandwich structure was placed around the workpiece. Silicon nitride could not be successfully cut. Mechanisms of material removal as well as a minimum level of workpiece electrical conductance necessary for EDM are proposed. Characterization of the surface damage resulting from electrical-discharge machining is presented. Recast, partially melted, and heat-affected zones are identified. The effects of parametric processing variations on surface integrity are discussed. Flexure strength and residual stress data are compared for EDM cut and diamond-ground surfaces in titanium diboride. Certain limitations are proposed for the EDM fabrication of ceramic components where surface defects are strength limiting.

22045 (AD-A—187141/7/XAB) Theory of the tetragonal-to-orthorhombic structural phase transition in La_2CuO_4. Technical report. Sahu, D.; George, T.F. (State Univ. of New York, Buffalo (USA). Dept. of Chemistry). Nov 1987. 13p. (UBUFFALO/DC—87/TR-60). NTIS, PC A03/MF A01.

A phenomenological free energy for the tetragonal-to-orthorhombic structural phase transition in La_2CuO_4 is derived from symmetry principles. The critical properties of the model free energy are studied by renormalization group methods and compared with experiment.

22046 **(ANL—87-24) X-ray computed tomography for structural ceramic applications: Beam hardening corrections.** Ellingson, W.A.; Segal, E.; Vannier, M.W. (Argonne National Lab., IL (USA)). May 1987. Contract W-31109-ENG-38. 29p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005891/JAW.

Beam hardening (BH), caused by the energy dependence of x-ray attenuation in materials, reduces the reliability of images generated by computed tomographic (CT) when polychromatic x-ray sources are used. The magnitude of the BH effect was calculated, and four different approaches to BH correction for CT imaging of ceramics were investigated: the "water bag" approach, prehardening of the beam by use of a filter, linearization correction, and dual-energy methods. The dual-energy approach appears to be a promising means of BH correction for CT imaging of ceramics. 23 refs., 22 figs.

22047 **(ANL/FE—87-2) Recent developments in nondestructive evaluation for structural ceramics.** Ellingson, W.A.; Roberts, R.A.; Vannier, M.W.; Ackerman, J.L.; Sawicka, B.D.; Gronemeyer, S.; Kriz, R.J. (Argonne National Lab., IL (USA)). May 1987. Contract W-31109-ENG-38. 29p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005889/JAW.

Advanced nondestructive evaluation methods are being developed to characterize ceramic materials and allow improvement of process technology. If one can determine porosity, map organic binder/plasticizer distributions, measure average through-volume and in-plane density, as well as detect inclusions, then process and machine operations may be modified to enhance the reliabilty of ceramics. Two modes of x-ray tomographic imaging - advanced film tomography and computed tomography - are being developed to provide flaw detection and density profile mapping capability. Nuclear magnetic resonance imaging is being developed to determine porosity and map the distribution of organic binder/plasticizer. Ultrasonic backscatter and through-transmission are being developed to measure average through-thickness densities and detect surface inclusions. 15 refs., 21 figs., 2 tabs.

22048 **(BNL—40757) High temperature superconductors in the La/sub 1+x/Ba/sub 2-x/Cu_3O/sub y/ system.** McCarron, E.M. III; Torardi, C.C.; Attfield, J.P.; Morrissey, K.J.; Sleight, A.W.; Cox, D.E.; Bordia, R.K.; Farneth, W.E.; Flippen, R.B.; Subramanian, M.A. (Du Pont de Nemours (E.I.) and Co., Wilmington, DE (USA). Central Research and Development Dept.; Brookhaven National Lab., Upton, NY (USA); Virginia Univ., Charlottesville (USA). Dept. of Physics). 1987. Contract AC02-76CH00016. 7p. (CONF-871124—85). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88006367/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (30 Nov 1987).

In the La Ba Cu oxide system the La ions can substitute on the Ba sites due to a close match in the ionic radius of the two (as opposed to the Y Ba Cu oxide system). Thus it is possible to make a solid solution La/sub 1+x/Ba/sub 2-x/Cu_3O/sub y/ where $O \sim x \leqq 0.5$ and $y \sim 7$. Several compounds of this family have been made, and their synthesis and crystal structure are described. $LaBa_2Cu_3O$/sub y/ can be made under high pressure O_2. This phase is orthorhombic: as the La content increases. La substitutes on the Ba sites until for La/sub 1.5/Ba/sub 1.5/Cu_3O/sub 7.33/, 1/4 of the Ba are replaced by La (disordered). This substitution changes the crystal symmetry from orthorhombic to tetragonal. The transition temperature and the critical current for various members of this series are presented. In particular, it will be shown that the midpoint in this series, La/sub 1.25/Ba/sub 1.75/Cu_3O/sub y/. Is a tetragonal bulk superconductor. Effect of various heat treatments on the superconducting properties is also presented. 19 refs., 3 figs., 2 tabs.

22049 **(CONF-870843—6) An overview of the monoclinic-tetragonal transformations in zirconia.** Garvie, R.C.; Chan, S.K. (Commonwealth Scientific and Industrial Research Organization, Clayton (Australia). Div. of Materials Science and Technology; Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 29p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88005926/JAW.

From International conference on electronic structure in phase stability in advanced ceramics; Argonne, IL, USA (17 Aug 1987).

A variety of experimental data obtained from single crystals and powders of zirconia has been examined in the light of a non-classical theory of nucleation. In this theory, the transformation is driven by partial softening of the shear mode of vibration associated with the decrease of the c_{44} elastic constant. The theory predicts an asymmetric relation between three critical temperatures. The assumption of a soft mode mechanism leads to a linear relationship between T/sub ss/, the transformation temperature of a zirconia/hafnia solid solution and 1/M/sub ss/, the reciprocal effective cation mass. All of these features are supported by the experimental data. Below the lower critical temperature T/sub c/, transformation proceeds homogeneously and not by nucleation and growth. The criterion of transformation is then determined by the balance of the change in volume free energy versus the change of the surface free energy. The occurrence of the t-structure in unconstrained crystallites at temperatures below T/sub c/ is interpreted in terms of such a description. 39 refs., 9 figs.

22050 **(CONF-870843—8) EXAFS [Extended X-ray Absorption Fine Structure] study of yttria stabilized cubic zirconia.** Veal, B.W.; McKale, A.G.; Paulikas, A.P.; Rothman, S.J.; Nowicki, L.J. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 24p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005921/JAW.

From International conference on electronic structure in phase stability in advanced ceramics; Argonne, IL, USA (17 Aug 1987).

EXAFS (Extended X-ray Absorption Fine Structure) studies of cubic (ZrO_2)/sub 1-x/(Y_2O_3)/sub x/ are reported for the concentration range $0.09 < x < 0.4$. When the trivalent Y ions are substituted for the tetravalent Zr ions, O^{2-} vacancies are also introduced for charge compensation. However, the distribution of the O^{2-} vacancies in the structure is not known. In this EXAFS study, systematics of disorder and vacancy distribution on the oxygen sublattice are monitored from both the Zr and Y sites as Y, and hence O^{2-} vacancy content, is varied. It is observed that oxygen vacancies occur adjacent to both Y and Zr ions but preferentially in proximity to Zr. 18 refs., 8 figs.

22051 **(CONF-871124—82) Theoretical studies of copper oxide clusters: Prediction of an electronically driven phase separation in YBa_2Cu_3O/sub x/.** Curtiss, L.A.; Brun, T.O.; Gruen, D.M. (Argonne National Lab., IL (USA)). Nov 1987. Contract W-31109-ENG-38. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005977/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (30 Nov 1987).

On the basis of semi-empirical extended Hueckel molecular orbital calculations of copper-oxide clusters representing the new superconducting material YBa_2Cu_3O/sub x/, a phase diagram is proposed which suggests that the 94°K high-temperature superconducting phase of YBa_2Cu_3O/sub x/ is characterized by an oxygen stoichiometry near 7.0. The phase diagram predicts that a plateau should exist for T/sub c/ in the region $x = 0.0$ to 0.25 and that in this region two phases are present which are characterized by compositions having oxygen stoichiometries 6.5 to 6.75 and ca. 7.0. 15 refs., 2 figs., 1 tab.

22052 **(CONF-8711114—4) X-ray absorption studies of La/sub 2-x/Sr/sub x/CuO_4 and Y/sub 1-x/Pr/sub x/Ba_2Cu_3O/sub 7-delta/.** Alp, E.E.; Shenoy, G.K.; Soderholm, L.; Goodman, G.L.; Hinks, D.G.; Veal, B.W.; Montano, P.A.; Ellis, D.E. (Argonne National Lab., IL (USA); Brooklyn Coll., NY (USA); Northwestern Univ., Evanston, IL (USA)). Dec 1987. Contract W-31109-ENG-38. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005982/JAW.

From Symposium on high temperature superconductors; Boston, MA, USA (30 Nov 1987).

The question of valence of Cu and rare-earth atoms in the newly discovered oxide superconductors with high transition temperatures is crucial to the understanding of their electronic structure. We have measured the X-Ray Absorption Near Edge Struc-

ture (XANES) of Cu K transition and Pr L/sub III/ transition to obtain information on the valence of Cu, and Pr in La/sub 2-x/Sr/sub x/CuO_4 and Y/sub 1-x/Pr/sub x/Ba_2Cu_3O/sub 7-δ/. We will present the experimental results, compare them with calculations of absorption cross-section for model atomic clusters, and discuss the valence of Cu as a function of oxygen concentration. 19 refs., 2 figs., 1 tab.

22053 **(CONF-8711115—5) Processing of nanophase ceramics.** Hahn, H.; Eastman, J.A.; Siegel, R.W. (Illinois Univ., Urbana (USA). Materials Research Lab.; Argonne National Lab., IL (USA)). Nov 1987. Contract W-31109-ENG-38. 11p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005985/JAW.

From 1. international conference on ceramic powder processing sciences; Orlando, FL, USA (1 Nov 1987).

The gas-condensation method for the production of small particles in the size range of 1 to 10 nm has recently enabled the synthesis of a new class of ultrafine-grained, nanophase ceramics. The first demonstrations of the synthesis of nanophase TiO_2 have shown that these ceramics, while already rather well bonded on compaction at room temperature, sinter rapidly above 500°C, with only small increases in grain size, leading to Vickers hardness and fracture toughness values comparable to or greater than those of coarser-grained compacts, but at some 400 to 600°C lower temperatures and without the need for sintering aids. 11 refs., 4 figs.

22054 **(DOE/ER/45117—3) High temperature corrosion of ceramics: Final report.** Blachere, J.R.; Pettit, F.S. (Pittsburgh Univ., PA (USA). Dept. of Materials Science and Engineering). 30 Dec 1987. Contract FG02-84ER45117. 113p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88006567/JAW.

Materials investigated were silica, alumina, silicon nitride and silicon carbide. In addition to the purer single crystals or CVD materials, typical engineering materials of various purities were included except for the silica which was vitreous. The corrosion conditions were 'hot corrosion' in which gaseous corrosion was enhanced by Na_2SO_4 deposits. Some gaseous corrosion and oxidation experiments were also performed. The hot corrosion was studied at 1000°C and at lower temperatures, in presence of pure oxygen and oxygen containing SO_2 and SO_3 (usually 1% SO_2 in 1 atm O_2 at room temperature). In general the extent of the degradation was small and weight changes were negligible or very small. The changes in morphology of the surfaces were observed in the scanning electron microscope. This instrument and the related x-ray microanalysis were the major tools of this research. A method of measurement of oxide thickness in the electron microprobe was developed for the experiments on silicon nitride and silicon carbide. The hot corrosion was strongly influenced by the impurity content of the aluminas, silicon nitrides and silicon carbides. The environmental conditions and the impurities affect the wetting (and corrosion) of the substrates by the sulfate. Bulk silica degrades in presence of Na_2SO_4 by devitrification and spalling. Alumina corroded more under acidic conditions. The morphologies of the corroded silicon nitrides and silicon carbides were studied in detail.

22055 **(INIS-mf—11124) Energy transfer processes in rare-earth compounds.** Buijs, M. (Rijksuniversiteit Utrecht (Netherlands)). 22 Jun 1987. 158p. NTIS (US Sales Only), PC A08/MF A01. Order Number TI88701759/JAW.

Contains summary in Dutch and previously published material.

In this thesis the results are described of an investigation into the radiationless transfer of electronic excitation energies in various Eu/sup 3+/ and Tb/sup 3+/ compounds, which show structural peculiarities in the rare-earth sublattice. These peculiarities are an one-dimensional sublattice as well as two different crystallographic locations for the rare-earth ion. 154 refs.; 43 figs.; 12 tabs.

22056 (INIS-SU—433, pp 65-71) **Inorganic materials synthesis in plasma and under accelerated electron beam.** Lifshits, E.V.; Shevyakova, Eh.P.; Polyashenko, R.F.; Kantsedal, V.P. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1987. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780050/JAW.

Voprosy Atomnoj Nauki i Tekhniki.; no. 1(39).

In Radiation damage physics and science of materials.

Methods of crystal optics and infrared spectroscopy were used to study synthesis peculiarities under irradiation and in plasma of a series of inorganic compounds: complex oxides (spinels NiCr/sub 2/O/sub 4/, NiAl/sub 2/O/sub 4/, ferrite NiFe/sub 2/O/sub 4/, solid solution (Fe, Cr)/sub 2/O/sub 3/) and model compound of orthosilicate Na/sub 2/MgSiO/sub 4/. Synthesis was performed by three methods: solid-phase sintering in air at 600-1500 deg C, in plasma of electric arc plasmatron and under accelerated electron beam. The investigations performed have shown that synthesis of complex oxide compounds under electron irradiation reaches maximum at a temperature by 200-300 deg C lower than synthesis temperature in a furnace. Oxide interaction in plasma during short time also results in complex compounds production. Comparison of synthesis conditions in plasma and under irradiation with an electron beam permits to consider that under an accelerated electron beam spinel- and ferrite formation reactions in binary oxide systems NiO-Gr/sub 2/O/sub 3/, NiO-Al/sub 2/O/sub 3/, NiO-Fe/sub 2/O/sub 3/ and Fe/sub 2/O/sub 3/-Cr/sub 2/O/sub 3/ proceed at lower temperatures which testifies that apart from thermal effect the radiation-stimulated diffusion processes affect considerably the synthesis course. 7 refs.; 4 figs.

22057 (INIS-SU—433, pp 72-74) **Neutron diffraction study of zirconium hydrides irradiated in a reactor channel.** Mandzhavidze, A.G.; Fedorov, V.M.; Gogava, V.V.; Shilo, S.I. (AN Gruzinskoj SSR, Tbilisi. Inst. Fiziki). 1987. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780050/JAW.

Voprosy Atomnoj Nauki i Tekhniki.; no. 1(39).

In Radiation damage physics and science of materials.

Neutron diffraction study into Zr/sub 1.75/ and Zr/sub 1.98/ hydrides irradiated with 9x10/sup 17/ neutr./cm/sup 2/ fluence in a nuclear reactor channel at temperature of about 150 deg C has been carriedon. Redistribution of reflexes (3) and (200) intensities and appearance of diffuse background asymmetrical relative to the diffraction peak (3) have been discovered on neutron diffraction patterns of irradiated Zr/sub 1.75/ hydride which is related to the appearance of concentrational inhomogeneities in irradiated hydride. Annealing at 200 deg C restores the initial distribution of hydrogen atom concentration in the specimen volume. 10 refs.; 2 figs.; 1 tab.

22058 **(LBL—21507) The role of powder packing in sintering.** De Jonghe, L.C.; Rahaman, M.N.; Lin, M. (Lawrence Berkeley Lab., CA (USA)). May 1986. Contract AC03-76SF00098. 20p. (CONF-860714—2). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006326/JAW.

From 22. University conference on ceramics - ceramic microstructures '86: role of interfaces; Berkeley, CA, USA (28 Jul 1986).

The densification of powder compacts, containing larger pores in a fine grain, homogeneous matrix, is considered. Homogenization of the porous microstructure is possible in the intermediate stage of densification due to grain growth driven coalescence of the finer pores, while the coarser pores grow less. The conditions are identified for which homogeneity can be achieved at the end of the intermediate stage. It is found that for finer powders the initial packing perfection, normalized to the grain size, has to increase rapidly. The effects of temperature and the relative merits of monodispersed versus multidispersed powders are also discussed. 13 refs., 5 figs.

22059 **(PB—88-133004/XAB) Research briefing on high-temperature superconductivity.** (National Research Council, Washington, DC (USA)). Oct 1987. 32p. NTIS, PC A03/MF A01.

This research briefing was prepared in response to the exciting new developments in superconductivity in ceramic-oxide materials announced earlier in 1987. The panel's specific charge was to examine not only the scientific opportunities in high-temperature superconductivity but also the barriers to commercial exploitation. While the base of experimental knowledge on the new superconductors is growing rapidly, there is as yet no generally accepted theoretical explanation of their behavior. The fabrication and proc-

essing challenges presented by the new materials suggest that the period of pre-commercial exploration for novel applications will probably extend for a decade or more. Near-term prospects for applications include magnetic shielding, the voltage standard, superconducting quantum interference devices, infrared sensors, microwave devices, and analog signal processing. The panel also identified a number of longer-term prospects in high-field and large-scale applications, and in electronics. This report discusses the United States' competitive position in the field, identifies major scientific and technological objectives for research and development, and concludes with a series of recommendations.

22060 **(PB—88-157706/XAB) Institute for Materials Science and Engineering, Ceramics: technical activities 1987.** (National Bureau of Standards, Washington, DC (USA). Ceramics Div.). Nov 1987. 86p. (NBSIR—87/3612). NTIS, PC A05/MF A01.

See also report for 1985, PB—86-196771.

Current programs of the Ceramics Division are reviewed. Among the significant accomplishments by the Division in 1987 are: The phase diagram for the superconducting YBaCuO system was determined and published. A diamond film deposition apparatus was constructed and successful deposition of diamond films demonstrated. A theoretical model of the role of surface forces in subcritical crack growth was developed. A time-resolved micro-Raman test system to analyze reactions at tribological contacts was developed. The interrelationships between processing, microstructure, and properties of superconducting YBaCuO were determined. A novel technique for measurement of sintering stress in ceramics was invented. Low-temperature sintering through the application of high pressure was demonstrated, with the potential for enhanced toughness through pressure-induced phase transformation. As part of the International Energy Agency (IEA) international powder characterization round-robin, 2000 silicon nitride reference powder samples were prepared, certified and distributed. Standard Reference Material 6406, silicon powder, was certified for calibration of x-ray line positions in x-ray powder diffraction. Techniques to predict the effect of filaments on crack-growth retardation in ceramic-matrix components were developed. The first data on the fracture behavior of superconducting ceramics as a function of sintering and annealing conditions were obtained. Volume 6 of Phase Diagrams for Ceramics was completed.

22061 **(PNL-SA—15087) Gamma-ray attenuation analysis of packing structure evolution during powder consolidation.** Schilling, C.H.; Aksay, I.A. (Pacific Northwest Lab., Richland, WA (USA); Washington Univ., Seattle (USA). Dept. of Materials Science and Engineering). Nov 1987. Contract AC06-76RL01830. 8p. (CONF-8711115—6). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88005682/JAW.

From 1. international conference on ceramic powder processing sciences; Orlando, FL, USA (1 Nov 1987).

Gamma-ray attenuation measurements enable nondestructive analysis of powder packing density heterogeneities which develop during consolidation of ceramic compacts. In situ measurements of gamma ray attenuation were performed during sedimentation of aqueous alumina suspensions to evaluate the role of suspension pH on particle rearrangement processes in cast layers. These data are used to support consolidation kinetic models describing processes of agglomerate restructuring and cast layer compaction.

22062 **(PNL-SA—15115) Specimen preparation techniques for the examination of ceramic and metal-matrix composites.** Saenz, N.T.; Parks, D.H.; Lavender, C.A.; Smith, M.T. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1987. Contract AC06-76RL01830. 13p. (CONF-8710253—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005157/JAW.

From ASM international composite session; Cincinnati, OH, USA (13 Oct 1987).

The need for stronger and lighter materials in industry and government has opened the door for many material applications of composite materials. With the emergence of ceramic and metal-matrix composites, new specimen preparation techniques are required to address the problems of polishing materials with varying mechanical and physical properties. Concerns about edge retention, interfacial flatness between microstructural constituents, polishing deformities or artifacts must be handled appropriately for an accurate microstructural analysis to be possible. The techniques developed specifically for composite materials will show differences in specimen preparation and polishing procedures, and illustrate how these adjustments have been successful in alleviating the problems mentioned. With the use of light optical microscopy in conjunction with other analytical methods, such as scanning electron microscopy and/or electron microprobe, a more complete picture of material analysis can be performed. 5 refs., 7 figs.

22063 **(PNL-SA—15181) Molecular spectroscopic characterization of binding interactions in phosphazene-stabilized alumina dispersions.** Exarhos, G.J.; Ferris, K.F.; Friedrich, D.M.; Samuels, W.D. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1987. Contract AC06-76RL01830. 9p. (CONF-8708221—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005154/JAW.

From 23. Materials Research Society university conference on ceramic science; Seattle, WA, USA (31 Aug 1987).

Fundamental research is directed toward developing new inorganic polymer dispersing agents, and clarifying the molecular interactions responsible for maintaining a dispersed colloidal phase. To minimize aggregation, particle-particle repulsion can be controlled through localized chemical interactions (polymer adsorption and steric repulsion). This condition is paramount for the production of low-void density ceramics prepared using colloidal processing techniques. 9 refs., 7 figs.

22064 **(UCRL—97672) HR coatings prepared from colloidal suspensions.** Thomas, I.M.; Wilder, J.G.; Gonzales, R.P. (Lawrence Livermore National Lab., CA (USA)). 26 Jan 1988. Contract W-7405-ENG-48. 12p. (CONF-8710165—7). NTIS, PC A03/MF A01; GPO Dep. Order Number DE88006235/JAW.

From Boulder damage symposium; Boulder, CO, USA (26 Oct 1987).

We have now established that sol-gel HR coatings prepared from colloidal oxide suspensions are superior to those prepared from solutions of precursor materials. Our investigation of single coatings of ZrO_2, HfO_2 and Al_2O_3 . H_2O prepared from suspensions has indicated that those from Al_2O_3 . H_2O have the highest laser damage threshold at 1064 nm. We have prepared HR coatings by stacking Al_2O_3 . H_2O and SiO_2, also prepared from suspension, in the conventional manner achieving reflectivity of 99% with 35 layers. The damage threshold of these materials has however only been about half that of single coats of the component oxides. 4 refs., 3 figs., 1 tab.

22065 **(UJV—7834-M) LWR fuel with gadolinium burnable poison.** Jakesova, L.; Havelka, S. (Ustav Jaderneho Vyzkumu CSKAE, Rez (Czechoslovakia)). Jun 1986. 28p. (In Czech). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701226/JAW.

English translation available from Nuclear Information Center, 156 16 Prague 5-Zbraslav, Czechoslovakia at US $10 per page. .

One of the methods of improving the use of nuclear fuel by better control of power and reactivity coefficient distribution, thus reducing the cost of the fuel cycle, is the application of burnable neutron poison, such as Gd/sub 2/O/sub 3/. A critical review is presented of available literature data on physical and chemical properties of Gd/sub 2/O/sub 3/ and the UO/sub 2/-Gd/sub 2/O/sub 3/ system. Attention is paid mainly to the phase diagram of the system, to oxygen stoichiometry and thermodynamical properties of mixed U and Gd oxides and to thermal conductivity of the UO/sub 2/-Gd/sub 2/O/sub 3/ system. The technology is described of production of mixed uranium-gadolinium fuel pellets as well as the problems involved. A table shows the parameters of homogeneity achieved for pellets containing up to 4 wt.% of Gd/sub 2/O/sub 3/ . Measures are listed necessary for testing such fuel. The neutron-physics properties of Gd and radiation behaviour of U-Gd fuel are characterized. The main benefits of Gd as a poison include relatively low poisoning of fuel by the end of the reactor campaign; it also allows suitable profiling of the radial and axial power distributions in the fuel assembly. A constraint for more extensive use of U-Gd

fuel in PWR's has so far been the scarcity of data on the behavior of fuel with higher Gd concentration. (A.K.). 15 figs., 13 tabs., 68 refs.

22066 **Static and dynamical properties of D^0/sub i/ (Li) in MgO:Li studied by EPR: Isotope effects.** Orera, V.M.; Sanjuan, M.L.; Abraham, M.M. (Instituto de Ciencia de Materiales de Aragon, Universidad de Zaragoza, 50009 Zaragoza, Spain). *Journal of Chemical Physics;* **88**: No. 5, 2976-2980(1 Mar 1988).

The D^0/sub i/ (Li) defect has been formed in MgO:Li and studied by EPR. The static spin Hamiltonian parameters, obtained from the angular dependence of the spectrum at LNT, are given and compared with those of H^0/sub i/ (Li). A noticeable isotope effect is found in the lithium shf interaction, which is explained as a consequence of the zero-point vibration of the hydrogen atom. The temperature evolution of the spectrum was also studied, and interpreted as a motional averaging process due to the reorientation of the defect among its eight equivalent <111> sites. Using the Liouville stochastic formalism, the EPR spectra were simulated as a function of the jump frequency (ω/sub e/) and fitted to the experimental ones. This yields the temperature dependence of ω/sub e/ which can be compared with that for the H^0/sub i/ (Li) defect. The isotope effects found, both in the activation energy and in the preexponential factor, are interpreted in the frame of the small-polaron theory.

22067 **Electron microscopy of electron damage in tantalum carbide.** Allison, C.Y.; Stoller, R.E.; Kenik, E.A. (Physics Department, Oklahoma State University, Stillwater, Oklahoma 74078). *Journal of Applied Physics;* **63**: No. 5, 1740-1743(1 Mar 1988).

An intermediate voltage (300-keV) transmission electron microscope was used to create carbon defects in situ in nearly stoichiometric tantalum carbide (TaC/sub 0.99/). At room temperature, these defects appeared as black spot damage. Varying the accelerating voltage allowed us to determine the threshold energy for carbon displacement to be 23.2 +- 1.1 eV. Electron irradiation at liquid-nitrogen temperature did not lead to the formation of observable defects. However, black spot damage became visible as the temperature of the specimen was raised to room temperature. Estimates of the size of defects produced were obtained by weak-beam dark-field imaging. These observations allowed us to assign a tentative physical interpretation to the three recovery stages seen in previous electron irradiation experiments using resistivity measurements.

22068 **Auger study of grain boundaries in large-grained YBa_2Cu_3O/sub x/.** Verhoeven, J.D.; Bevolo, A.J.; McCallum, R.W.; Gibson, E.D.; Noack, M.A. (Ames Laboratory and Department of Materials Science and Engineering, Iowa State University, Ames, Iowa 50011). *Applied Physics Letters;* **52**: No. 9, 745-747(29 Feb 1988). Contract W-7405-ENG-82.

A scanning Auger microscopy study has been carried out on fractured surfaces of YBa_2Cu_3O/sub x/ samples prepared by standard sintering procedures from powders. It is concluded that in the large-grained samples examined, a majority of the grain boundaries are sufficiently "open" that standard metallographic preparation causes them to become contaminated with C. This suggests that an actual loss of contact at the grain boundaries during sample preparation is responsible for the low J/sub c/ values observed in bulk-sized large-grained YBa_2Cu_3O/sub x/.

22069 **Characterization of planar crystal lattice defects in the high-temperature superconductor $YBa_2Cu_3O_7$.** Tafto, J.; Suenaga, M.; Sabatini, R.L. (Materials Science Division, Brookhaven National Laboratory, Upton, New York 11973). *Applied Physics Letters;* **52**: No. 8, 667-668(22 Feb 1988). Contract AC02-76CH00016.

Transmission electron microscopy shows that sintered $YBa_2Cu_3O_7$ contains many planar defects in the a-b plane. They range from stacking faults to 10—100 nm thick sheets of disordered material that extend through the entire crystal grains. The stacking faults may be precursors for the thick layers of disordered material. In this letter we characterize the stacking faults and find that the displacement vector switches from (a/2,0,c/6) to (b/2,0,c/6) as the faults cross the twin boundaries.

22070 **Is the isotope effect absent in YBa_2Cu_3O/sub 7-// sub δ/?.** Grimsditch, M.; Brun, T.O.; Bhadra, R.; Dabrowski, B.; Hinks, D.G.; Jorgensen, J.D.; Beno, M.A.; Liu, J.Z.; Schuttler, H.B.; Segre, C.U.; and others. (Materials Science and Chemistry Divisions, Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review Letters;* **60**: No. 8, 752-752(22 Feb 1988). Contract W-31-109-ENG-38.

A Comment on the Letter by B. Batlogg et al., Phys. Rev. Lett. 58, 2333 (1987).

22071 **Cluster framework structures and relationships. Two compounds wit a new connectivity, $K_2Zr_6Cl_{15}B$ and $K_3Zr_6Cl_{15}Be$.** Ziebarth, R.P.; Corbett, J.D. (Iowa State Univ., Ames). *Journal of the American Chemical Society;* **110**: No. 4, 1132-1139(17 Feb 1988).

The title compounds are obtained in high yield by reaction of stoichiometric quantities of $ZrCl_4$, KCl, powdered Zr, and the interstitial element B or Be in sealed tantalum containers at 800-850°C for 2-3 weeks. The structures were established by single-crystal means to be orthorhombic for $K_2Zr_6Cl_{15}B$ (Cccm, Z = 4, R = 3.3, R/sub w/ = 4.1) and monoclinic for $K_3Zr_6Cl_{15}Be$ (C2/c, Z = 4, R = 4.8, R/sub w/ = 3.2). Both contain crisscrossing linear chains of trans-bridged clusters ...[Zr_6Cl_{12}B(Be)]-Cl/sup a-a/... that are further interconnected by bent Cl/sup a-a/ bridges at the remaining four metal vertices. The low symmetry of one cation site in $K_2Zr_6Cl_{15}B$ is noteworthy. The change of the interstitial atom in $K_3Zr_6Cl_{15}Be$ forces an orthorhombic to monoclinic structural distortion in order to accommodate a third cation. The distortion is accomplished mainly by rotation of the linear chains in alternate directions, which splits the former low-symmetry cation site into two. The four distinct (M_6X_{12})X/sup a-a//sub 6/2/ framework structures exhibited in the Ta_6Cl_{15}, $CsNb_6Cl_{15}$, $K_2Zr_6Cl_{15}B$, and Nb_8F_{15} parent types are compared and systematized in terms of the three-dimensional cluster connectivity, ring size, and local Cl/sup a-a/ geometry. The choice among these for various M/sub x//sup I/ ($Zr_6Cl_{12}Z$)Cl/sub 6/2/ compounds is evidently dictated by the size of the interstitial Z and the need to accommodate cations of various sizes and numbers, and the last is in turn largely governed by the electronic nature of the interstitial element Z.

22072 **Electronic structure due to hydrogen and vanadium as substitutional impurities in InP.** Khowash, P.K.; Ellis, D.E. (Department of Physics and Astronomy and Materials Research Center, Northwestern University, Evanston, Illinois 60201). *Physical Review* [*Section*] *B: Condensed Matter;* **37**: No. 6, 2973-2978(15 Feb 1988).

The self-consistent local-density theory is used in a cluster model to calculate the charge distribution, one-electron energy spectra, and the density of states for pure InP and for H and V substituted at the In site. The pure semiconductor gap is found to be 0.8 eV, consistent with experiments. The hydrogen impurity introduces a trapping center at E/sub v/+0.37 eV in the gap region: a semi-insulating-like behavior. The transition metals are generally found to introduce deep levels in the gap region, but for vanadium we find the gap swept clean of any impurity level, with the last partially occupied state close to the bottom of the conduction band. This is consistent with deep-level transient spectroscopy experiments where no vanadium-related deep levels in the band gap are found down to 4 K.

22073 **Calculation of electronic and structural properties of BC_3.** Tomanek, D.; Wentzcovitch, R.M.; Louie, S.G.; Cohen, M.L. (Department of Physics, University of California, Berkeley, Berkeley, California 94720). *Physical Review* [*Section*] *B: Condensed Matter;* **37**: No. 6, 3134-3136(15 Feb 1988).

We have determined the equilibrium geometry and electronic structure of the compound, BC_3 using the ab initio pseudopotential local orbital approach and the local-density functional formalism. The boron-carbon compound, BC_3, is a layered material with gra- phitic structure, where every fourth carbon atom is substituted by boron. The nearest-neighbor distances are predicted to be 1.42

A for the C-C bond and 1.55 A for the B-C bond. A monolayer of BC_3 is found to be a semiconductor, and the observed metallic behavior of the bulk sample arises from interactions between neighboring layers in BC_3 with AA and AB stacking. Based on total-energy calculations, we find BC_3 to be less stable than graphite for the structures investigated.

22074 **Band electronic structure of the lithium molybdenum purple bronze Li/sub 0.9/Mo_6O_{17}.** Whangbo, M.H.; Canadell, E. (North Carolina State Univ., Raleigh). *Journal of the American Chemical Society;* **110**: No. 2, 358-363(20 Jan 1988). Contract FG05-86ER45259.

The electronic structure of Li/sub 0.9/Mo_6O_{17} was examined by performing tight-binding band calculations, and the calculated band electronic structure was analyzed in terms of orbital interactions analysis. Li/sub 0.9/Mo_6O_{17} is three-dimensional in crystal structure but pseudo-one-dimensional (1D) in electrical properties, because the partially filled d-block bands of Li/sub 0.9/Mo_6O_{17} originate primarily from the Mo_4O_{16} chains embedded in the Mo_4O_{15} octahedral layers. Of the four filled d-block bands of Li/sub 0.9/Mo_6O_{17}, two partially filled bands are dispersive along the Mo_4O_{16} direction. Each of these two bands provides an identical 1D Fermi surface nested by the vector q ~/= (0, 0.45b*, 0). Therefore, it is likely that Li/sub 0.9/Mo_6O_{17} is susceptible to either a charge or spin density wave formation associated with the nesting vector. The resistivity upturn at 25 K and the superconductivity at ~ 1.9 K in Li/sub 0.9/Mo_6O_{17} were discussed on the basis of the calculated Fermi surface.

22075 **Simulation of crystal structures by empirical atom-atom potentials. 2. The orthorhombic-to-tetragonal phase transition in the high-temperature (T/sub c/ > 90 K) superconductor YBa_2Cu_3O/sub 7-y/.** Evain, M.; Whangbo, M.H.; Beno, M.A.; Williams, J.M. (North Carolina State Univ., Raleigh). *Journal of the American Chemical Society;* **110**: No. 2, 614-616(20 Jan 1988). Contract FG05-86ER45259;W-31-109-ENG-38.

Empirical atom-atom potentials are used to determine unit cell and atom position parameters for YBa_2Cu_3O/sub 7-y/. Particular attention is given to the orthorhombic to tetragonal phase transition for this high temperature superconductor.

22076 **Effect of oxygen incorporation on the structure of ion-beam-assisted LaF_3 thin films.** Targrove, J.D.; Lingg, L.J.; Lehand, J.P.; Macleod, H.A. (Air Force Institute of Technology, Department of Engineering Physics, Wright-Patterson Air Force Base, Ohio 45433). *Applied Optics;* **27**: No. 2, 213-215(15 Jan 1988).

The percentage of oxygen in the crystalline lattice of ion-assisted-deposition Lanthanum fluorides is shown to increase with increasing ion beam current density. (AIP)

22077 **(N—88-14201) Glassy GeO_2 obtained by the gel process.** Voigt, B. Translated from *Zeitschrift fuer Chemie ;* **24**: No. 4, 143-144(Nov 1987). 6p. (NASA-TT—20125; NAS—1.77:20125). NTIS, PC A02/MF A01.

A comparison is made between GeO_2 glass produced by the gel process and by a combined gel and thermal process. The latter appears to be more effective.

22078 **Electronic structure and excitonic-enhanced superconducting mechanism in YBa_2Cu_3O/sub 7-//sub δ/.** Ching, W.Y.; Xu, Y.; Zhao, G.; Wong, K.W.; Zandiehnadem, F. (Department of Physics, University of MissouriKansas City, Kansasa City, Missouri 64110). *Physical Review Letters;* **59**: No. 12, 1333-1336(21 Sep 1987).

On the basis of the calculated electronic structure, an excitonic-enhanced superconducting mechanism is used to explain the high T/sub c/ superconductivity in YBa_2Cu_3O/sub 7-//sub δ/ system.

22079 **Plastic incompatibility and crack nucleation during deformation on four independent slip systems in tungsten carbide-cobalt.** Jayaram, V. (Center for Advanced Materials, Lawrence Berkeley Lab., Berkeley, CA 94720). *Acta Metallurgica;* **35**: No. 6, 1307-1316(Jun 1987).

The problem of slip transfer across grain boundaries is considered for the case of a hexagonal material that is plastically inextensible along [0001]. The discontinuity in tensile strain that must necessarily exist across a grain boundary is a cause of intergranular and transgranular cracking on the basal plane. Intergranular cracking at many grain junctions and two-grain junctions arise out of in-plane and normal strain differences across grain boundaries, respectively. Experimental evidence from deformed WC-Co is adduced to support these predictions. Transgranular cracking on the basal plane occurs only in coarse grained material. Thin (≃500A) layers of cobalt between carbide grains do not appear to appreciably affect the onset of cracking if it is expected from an incompatibility standpoint. The implications of these results are discussed for the general case of deformation of brittle solids, both with and without a superimposed constraining pressure.

22080 **Ion implantation and annealing of oxides.** White, C.W.; Boatner, L.A.; Sklad, P.S.; McHargue, C.J.; Pennycock, S.J.; Aziz, M.J.; Farlow, G.C.; Rankin, J. (Oak Ridge National Lab., Oak Ridge, TN 37831). pp 357-364 of Beam-solid interactions and transient processes. Thompson, M.O.; Picraux, S.T.; Williams, J.S. Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—). Contract AC05-84OR21400.

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

Ion implantation damage and annealing results are presented for a number of crystalline oxides. In Al/sub 2/O/sub 3/, the amorphous phase produced by ion bombardment of the pure material first crystallites in the (crystalline) γ phase. This is followed by the transformation of γ-Al/sub 2/O/sub 3/ to α-Al/sub 2/O/sub 3/ at a well defined interface. The activation energy for the growth of α alumina from γ is 3.6 eV/atom. In CaTiO/sub 3/, the implantation-induced amorphous phase transforms to the crystalline phase by solid-phase epitaxy (SPE). ZnO is observed to remain crystalline even after high implantation doses at liquid nitrogen temperatures. The near surface of KTaO/sub 3/ is transformed to a polycrystalline state after implantation at room temperature or liquid nitrogen temperature.

22081 **Damage production in β-SiC during ion implantation.** Withrow, S.P.; More, K.; Edmond, J.A.; Kong, H.S.; Maziasz, P.J.; Davis, R.F. (Oak Ridge National Lab., Oak Ridge, TN 37831). pp 373-378 of Beam-solid interactions and transient processes. Thompson, M.O.; Picraux, S.T.; Williams, J.S. Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—). Contract AC05-76OR00033.

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

Damage in single crystal-β-SiC(100) as a result of ion bombardment has been studied using Rutherford backscattering (RBS) and cross-section transmission electron microscopy (X-TEM). Samples were implanted with 123 keV /sup 27/Al at liquid nitrogen temperature. RBS spectra for He channeling in the (110) axis at 45° were obtained as a function of implantation dose to determine damage accumulation. X-TEM was used to characterize damage structure for selected doses. The surface of the SiC becomes amorphous for doses greater than 1 x 10/sup 15/ /cm/sup 2/. At lower doses, significant uniaxial lattice strain along the (100) direction is suggested by comparison of RBS channeling spectra obtained for several high index axes. High resolution TEM on a sample implanted at 4 x 10/sup 14/ /cm/sup 2/ shows no damage structure in the surface region; lattice damage in a broad layer centered roughly at the depth of highest energy deposition is characterized by small amorphous pockets in a crystalline matrix. Qualitatively similar backscattering results were obtained for other elements implanted at room and liquid nitrogen temperature.

22082 **High pressure explosive processing of ceramics.** Graham, R.A.; Sawaoka, A.B. Aedermannsdorf, Switzerland; Trans Tech Publications (1987). 412p.

The papers presented in this volume provide an overview of current developments in the field of explosive processing of ceramics. Topics discussed include explosive processing methods, dense boron nitride synthesis, shock-activated sintering, hot pressing of shock-modified powders, and the mechanism of phase changes

under shock processes. Papers are also presented on the dynamic compaction of aluminum nitride powder, X-ray diffraction line broadening of shock-modified ceramic powders, and explosive synthesis of diamond.

22083 **Magnetic field penetration depth of $La(1.85)Sr(0.15)CuO_4$ measured by muon spin relaxation.** Kossler, W.J.; Kempton, J.R.; Yu, X.H.; Schone, H.E.; Uemura, Y.J. pp 7133-7136 of High-temperature superconductivity. New York, NY; American Physical Society (1987).

Muon-spin-relaxation measurements have been performed on a high-Tc superconductor, La(1.85)Sr(0.15)CuO_4. In an external transverse magnetic field of 500 G, a magnetic field penetration depth of 2000 A at T = 10 K has been determined from the muon-spin-relaxation rate which increased with decreasing temperature below Tc. From this depth and the Pauli susceptibility, the superconducting carrier density is estimated at 3 x 10 to the 21st per cu cm. The zero-field relaxation rates above and below Tc were equal, which suggests that the superconducting state in this sample is not associated with detectable static magnetic ordering. 11 references.

22084 **High-resolution synchrotron X-ray study of the structure of La(1.8)Ba(0.2)CuO(4-y).** Moss, S.C.; Forster, K.; Axe, J.D.; You, H.; Hohlwein, D. pp 7195-7198 of High-temperature superconductivity. New York, NY; American Physical Society (1987).

X-ray diffraction of La(1.8)Ba(0.2)CuO(4-y) reveals two macroscopically segregated tetragonal (K_2NiF_4-type) phases of nearly identical lattice parameter. Many peaks show additional broadening upon cooling. This broadening is consistent with a spontaneous monoclinic distortion, with an onset temperature of about 150 K, and is possibly relevant to the superconducting properties. Small single crystals of about 70 micron diameter within the powder aggregate are also studied and show a similar two-phase constituency and a resolvable peak splitting at low temperature. 17 references.

22085 **High pressure explosive processing of ceramics.** Graham, R.A.; Sawaoka, A.B. Aedermannsdorf, Switzerland; Trans Tech SA (1986). 400p. Trans Tech SA, Trans Tech House, Aedermannsdorf, Switzerland CH-4711.

The use of high pressure explosive loading to consolidate and modify ceramic materials is newly emerging as a significant prospective materials processing technique. This book presents information in this materials area. Materials reported on include silicon nitride, silicon carbide, rutile, alumina, boron nitride, diamond, aluminum nitride, titanium carbide and titanium diboride.

3606 Other Materials

REFER ALSO TO CITATION(S) 21049, 21237, 21324, 21325, 21327, 21327, 21554, 22062, 22194, 22284, 22297, 22329, 22330, 22331, 22332, 22334, 22335, 22336, 22415, 22585, 23778, 23936

22086 **(AD-A—186941/1/XAB) Micromechanisms of fatigue crack growth and fracture toughness in metal-matrix composites. Interim technical report, 31 July-31 October 1987.** Davidson, D.L. (Southwest Research Inst., San Antonio, TX (USA)). Nov 1987. 28p. (SWRI—06-8602). NTIS, PC A03/MF A01.

Fracture toughness of several composites of aluminum alloys reinforced with particulate SiC was measured. Variables were particle size and volume fraction, and matrix alloy composition and heat treatment. Fracture surface profiles were measured and related to fractile dimension using the techniques of quantitive metallography. Fracture surface roughness was described well by fractals, but fracture toughness did not correlate with any measure of fracture roughness. An explanation for this behavior is offered.

22087 **(AD-A—187077/3/XAB) Dispersive hole transport in SiO_2. Final report, 1978-1987.** McLean, F.B.; Boesch, H.E.; McGarrity, J.M. (Harry Diamond Labs., Adelphi, MD (USA)). Oct 1987. 57p. (HDL-TR—2117). NTIS, PC A04/MF A01.

A detailed study is presented on the temperature, field, and thickness dependencies of the transient, radiation-induced hole transport in thin films of amorphous SiO_2 employed as the gate oxides of metal-oxide-semiconductor (MOS) structures. The samples used in the investigation are clean, radiation-hardened oxides in which less than 2% of the holes generated are permanently trapped and therefore are ideal for basic transport studies. The measurements show that for the entire range of temperature (78 to 293 K), field (1 to 6 MV/cm), and thickness (22 to 99 nm) investigated, the time dispersion of the transport can be adequately described by the continuous-time-random-walk (CTRW) model with a single value of the disorder parameter: alpha = 0.25 + or - 0.03. This is a crucial result which indicates rather strict universality of the hole transport with respect to temperature, field, and thickness in clean amorphous SiO_2. Changes in these parameters simply affect the time scale for the transport, but not the shape or overall dispersion of the response curves. The observed universality feature has implications for the microscopic basis of the transport, namely that the hole transport proceeds via hopping between localized trapping sites in the SiO_2 film, with the dispersion originating primarily from a broad distribution of intersite transfer integrals.

22088 **(AD-A—187101/1/XAB) Spectroscopic ellipsometry and x-ray photoelectron spectroscopy studies of the annealing behavior of amorphous Si produced by Si ion implantation.** Vasquez, R.P.; Madhukar, A.; Tanguay, A.R. (University of Southern California, Los Angeles (USA). Dept. of Materials Science). 15 Sep 1985. 8p. NTIS, PC A02/MF A01.

Pub. in Jnl. of Applied Physics, Vol. 58, No. 6, 2337-2343(15 Sep 1985).

The dielectric functions of a-Si prepared by Si ion implantation in Si and of subsequently thermally annealed a-Si were measured by means of spectroscopic ellipsometry. Differences are observed that may be accounted for only partially by differences in the surface condition of the samples. Intrinsic changes in the bond polarizability are thus indicated. Comparison of the x-ray photoemission results for the Si 2p core levels and the valence-band states of the as-implanted and anneal-stabilized a-Si samples reveals measurable changes in the valence charge distribution sufficient to substantiate a change in the bond polarizability.

22089 **(AD-A—187221/7/XAB) Analytical and experimental characterization of damage processes in composite laminates. Annual progress report, June 1986-July 1987.** Dvorak, G.J.; Laws, N. (Rensselaer Polytechnic Inst., Troy, NY (USA). Dept. of Civil Engineering). Jul 1987. 36p. NTIS, PC A03/MF A01.

This report presents a brief summary of results obtained in the research program on damage development in fibrous composite laminates. The following technical subjects are described: (i) Effect of fiber breaks on stiffness changes in unidirectional composites. (ii) Stress analysis of transverse cracks. (iii) Progressive transverse cracking of 0/90 laminates. (iv) Analysis of cracks approaching a boundary between two materials. (v) Fatigue of B/Al laminates.

22090 **(AD-A—187547/5/XAB) Preparation of superconducting YBa_2Cu_3Ox thin films by oxygen annealing of multilayer metal films.** Tsaur, B.Y.; Dilorio, M.S.; Strauss, A.J. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 14 Sep 1987. 5p. (JA—6021). NTIS, PC A02/MF A01.

Pub. in Applied Physics Letter, Vol. 51, No. 11, 858-860(14 Sep 1987).

Superconducting thin films consisting perdominantly of yttrium barium copper oxide have been prepared by oxygen annealing of metal films formed by using electron-beam evaporation to deposit a three-layer sequence of Cu, Ba, and Y in nominally stoichiometric proportions, then repeating the sequence five times. For the best superconducting films, which were prepared on yttria-stabilized cubic zirconia substrates, the onset of superconductivity occurred at 94 K and zero resistivity was observed at 72 K. For the best films prepared on sapphire substrates, the corresponding temperatures were 95 and 40 K.

22091 **(ANL/FE—87-7) Nondestructive evaluation of pack-diffusion coatings: A review and preliminary results.** Gopalsami, N.; Ellingson, W.A.; Roberts, R.A.; Rose, D.N. (Argonne National Lab., IL (USA)). Dec 1987. Contract W-31109-ENG-38. 36p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005491/JAW.

This report reviews potential nondestructive evaluation (NDE) methods for coatings applicable to heat recovery systems of coal gasifiers. The review focuses mainly on aluminized, chromized, or simultaneously aluminized/chromized coatings that are produced by pack-diffusion processes on low-alloy steels such as 2 1/4Cr-1Mo and A106 carbon steels. Nondestructive evaluation is required for characterization of as-received coatings relative to acceptance criteria, and for inspection of field fabrication and repairs. In addition, NDE should play an integral role in the formulation of optimum coating specifications by establishing a relationship between coating parameters and the observed corrosion behaivor in heat-recovery system environments. NDE methods reviewed are thermal-wave imaging, scanning acoustic microscopy, ultrasonic backscattered surface waves, eddy-current testing, and X-ray fluorescence. 31 refs., 15 figs.

22092 **(BNL—40712) Ordered thin films of polyheterocycles electrochemical polymerization and Langmuir-Blodgett film formation.** Skotheim, T.A.; Yang, X.Q.; Inagaki, T.; Samuelsen, L.; Tripathy, S.; Lee, H.S.; Okamoto, Y. (Brookhaven National Lab., Upton, NY (USA); Lowell Univ., MA (USA). Dept. of Chemistry; Polytechnic Univ., Brooklyn, NY (USA). Dept. of Chemistry). 1987. Contract AC02-76CH00016. 13p. (CONF-8711151—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005609/JAW.

From International symposium on development of conducting organic polymers and ultra thin films and their use in electronics; Stockholm, Sweden (2 Nov 1987).

We have demonstrated that ordered thin films of oxidized polyheterocycles can be produced both with electrochemical growth and Langmuir-Blodgett film formation. Traditional electrochemical growth processes yield films which may be ordered in the neutral, or reduced, state but assume a disordered and amorphous structure upon intercalation of anions. However, by manipulating the electrochemical growth process by complexing with organic macrocyclic anions, it may be possible to grow structures which are ordered in the oxidized state as well. The Langmuir-Blodgett technique provides an elegant method for a rational design of ordered structures of electroresponsive polymeric systems. It is anticipated that this will have important applications in a number of technologies which rely on optically and electrically active interfaces. 6 figs.

22093 **(BNL—40722) The SiO_2/Si interface probed with positrons.** Nielsen, B.; Lynn, K.G.; Leung, T.C.; Welch, D.O.; Rubloff, G. (Brookhaven National Lab., Upton, NY (USA); International Business Machines Corp., Yorktown Heights, NY (USA). Thomas J. Watson Research Center). 1987. Contract AC02-76CH00016. 7p. (CONF-871124—86). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88006361/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (30 Nov 1987).

The effects of the heat treatment of Si covered with a thermally-grown ~50 nm overlayer of SiO_2 were probed by means of measurements of positron annihilation characteristics obtained with a variable-energy positron beam. From measurements at elevated temperature (~500°C) it was observed that positrons implanted overlapping the SiO_2/Si interface decay from a state with properties distinctively different from the state in Si and in SiO_2. The nature of the annihilation characteristics indicates the presence of open volume defects. 19 refs., 2 figs., 1 tab.

22094 **(BNL—40764) An infrared reflection spectroscopy study of orientational behavior in poly(3-methylthiophene) on a Pt surface.** Yang, X.Q.; Inagaki, T.; Chen, J.; Skotheim, T.A.; Okamoto, Y. (Brookhaven National Lab., Upton, NY (USA); Polytechnic Univ., Brooklyn, NY (USA). Dept. of Chemistry). 1987. Contract AC02-76CH00016. 14p. (CONF-8710283—2). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006368/JAW.

From Symposium on electroresponsive polymers; Upton, NY, USA (4 Oct 1987).

Infrared reflection-absorption spectroscopy (IRRAS) has been used to obtain the vibrational spectra of thin films of poly(3-methylthiophene) electrochemically polymerized on a platinum surface. Clear orientational effects, with the thiophene rings oriented parallel to the platinum surface, were observed when the thickness of the polymer films were within a few hundred Angstroms. 17 refs., 4 figs.

22095 **(BNL—40771) Structure and phase transitions in PEO[poly(ethylene oxide)]-KI complexes.** Yang, X.Q.; Chen, J.; Harris, C.S.; Skotheim, T.A.; den Boer, M.L.; Mei, H.; Okamoto, Y.; Kirkland, J. (Brookhaven National Lab., Upton, NY (USA); Hunter Coll., New York (USA). Dept. of Physics and Astronomy; Polytechnic Univ., Brooklyn, NY (USA). Dept. of Chemistry; Naval Research Lab., Washington, DC (USA)). 1987. Contract AC02-76CH00016. 11p. (CONF-8710283—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006370/JAW.

From Symposium on electroresponsive polymers; Upton, NY, USA (4 Oct 1987).

It is generally accepted that PEO (poly(ethylene oxide)) electrolytes are not single-phase, homogeneous materials in the ranges of composition and temperature of interest for batteries and other low temperature electrochemical devices. The polymer-salt mixtures often contain multiple phases, which makes detailed analysis of structure and transport properties difficult. This paper shows that x-ray absorption experiments can be used to study the microscopic structural parameters of these materials, and that microstructural information thus obtained can be correlated with macroscopic thermodynamic and transport data. The conclusion drawn from the the studies of PEO-KI complexes is that the transition to a higher conductivity phase at elevated temperatures is associated with a decreasing oxygen coordination number of the K^+ ion.

22096 **(CONF-871124—77) In situ TEM observations of heavy ion damage in gallium arsenide.** Bench, M.W.; Robertson, I.M.; Kirk, M.A. (Illinois Univ., Urbana (USA). Dept. of Materials Science and Engineering; Argonne National Lab., IL (USA)). Jan 1988. Contract W-31109-ENG-38. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005984/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (30 Nov 1987).

Transmission electron microscopy experiments have been performed to investigate the lattice damage created by heavy-ion bombardments in GaAs. These experiments have been performed in situ by using the HVEM - Ion Accelerator Facility at Argonne National Laboratory. The ion bombardments (50 keV Ar^+ and Kr^+) and the microscopy have been carried out at temperatures ranging from 30 to 300°K. Ion fluences ranged from 2×10^{11} to 5×10^{13} ions cm^{-2}. Direct-impact amorphization is observed to occur in both n-type and semi-insulating GaAs irradiated to low ion doses at 30°K and room temperature. The probability of forming a visible defect is higher for low temperature irradiations than for room temperature irradiations. The amorphous zones formed at low temperature are stable to temperatures above 250°K. Post-implantation annealing is seen to occur at room temperature for all samples irradiated to low doses until eventually all visible damage disappears. 14 refs., 3 figs., 1 tab.

22097 **(CONF-871124—88) An ion beam simulation of the swelling of U_3Si.** Allen, C.W.; Birtcher, R.C.; Rehn, L.E.; Hofman, G.L. (Argonne National Lab., IL (USA)). Dec 1987. Contract W-31109-ENG-38. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005980/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (30 Nov 1987).

Uranium intermetallics are under consideration as possible low-enrichment reactor fuels. These materials divide into two classes with regard to dimensional stability during their service lifetime: those which suffer extreme dimensional growth and those which do not. It has been suggested that the rapid-swelling materials are those that become glassy under irradiation while the low-swelling materials are those that remain crystalline. The structural and di-

mensional stabilities of U_3Si (depleted uranium) have been investigated as a function of temperature during Kr irradiation by in situ HVEM observations. Below 550°K, this material becomes glassy during 1.0 MeV Kr irradiation. Prolonged irradiation at 475°K also leads to rapid darkening of the TEM bright field image of the specimen, growth of the initial perforation at rates which far exceed those due to sputtering, and formation of additional thin areas and holes. Irradiation at 615°K does not result in observable image darkening or rapid growth of the initial perforation. After 2 x 10^{20} Kr m^{-2}, the crystalline material irradiated at 615°K is stabilized against subsequent ion-irradiation-induced amorphization and growth at 475°K. Similarly, after 2 x 10^{20} Kr m^{-2} at 475°K, the glassy phase persists at 620°K under additional Kr irradiation, and the rapid growth continues. The mechanism of the irradiation-induced growth of the glassy material does not involve gas precipitation but rather may involve deformation by viscous flow assisted by the defects generated during irradiation. 12 refs., 3 figs.

22098 **(CONF-8711157—1) The structure of the boron-hydrogen complex in silicon.** Marwick, A.D.; Oehrlein, G.S.; Barrett, J.H.; Johnson, N.M. (International Business Machines Corp., Yorktown Heights, NY (USA). Thomas J. Watson Research Center; Oak Ridge National Lab., TN (USA); Xerox Palo Alto Research Center, CA (USA)). 1987. Contract AC05-84OR21400. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005433/JAW.

From Symposium on defects in electronic materials; Boston, MA, USA (30 Nov 1987).

Channeling and lattice location has been used to investigate the structure of the boron-hydrogen complex in crystalline silicon. The positions of both the boron and hydrogen atoms have been determined. Results are compared with Monte-Carlo simulations. The boron atom in the B-H pair is found to be displaced from a substitutional site by 0.28 +- 0.03 A, while the hydrogen atom is predominantly at a bond-center site, with a small proportion in a back-bonded position. 10 figs., 22 refs.

22099 **(CRN-CPR—87-05) Fast thermal annealing of implantation defects in silicon. Solid phase epitaxy and residual imperfection recovery.** Adekoya, O.A. (Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires; Strasbourg-1 Univ., 67 (France)). Jun 1987. 288p. (In French). NTIS (US Sales Only), PC A13/MF A01. Order Number DE88752108/JAW.

Basic processes ruling the crystal reconstitution in solid phase during fast thermal annealing are studied; the role of electronic and thermodynamic effects at the interface is precised, following the implantations of a donor element (p/sup +/), an acceptor element (B/sup +/) and an intrinsic element (Ge/sup +/). Then, after recrystallization, the electric role of residual point defects is shown together with the possibility of total recovery and an important electric activation of the doping.

22100 **(CSNSM-T—87-01) High energy ion irradiation effects in H/sub 2/O ice and astrophysical applications.** Benit, J. (Paris-11 Univ., 91 - Orsay (France). Centre de Spectrometrie Nucleaire et de Spectrometrie de Masse; Paris-11 Univ., 91 - Orsay (France)). Jun 1987. 120p. (In French). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88752138/JAW.

This thesis presents the study of radiation effects induced in H/sub 2/O ice by MeV/u ions: desorption of ionized species, "erosion" of the irradiated film and molecular synthesis within the ice. The desorption is analysed by time of flight mass spectroscopy. We describe the mass spectra of the desorbed ions, both positively and negatively charged, up to 400 uma. The absolute yields are given, as well as their dependence with the energy and energy loss of the primary ions. The "erosion" of the ice is analysed by infrared spectroscopy, on line during the irradiation. Absolute yields are derived, as a function of the ions beam flux, the mass and energy of the ions, and the thickness of the samples. A linear dependence of the yield with the thickness is interpreted as follows: the erosion comes primarely from the dissociation of the molecules all along the ion tracks. In conclusion some astrophysical implications of the results are discussed in the framework of irradiation of icy material in a variety of environments.

22101 **(DOE/ER/13181—T2) The hydrophobic character of nonsulfide mineral surfaces as influenced by double-bond reaction of adsorbed unsaturated collector species: Progress report for 2nd year.** Miller, J.D. (Utah Univ., Salt Lake City (USA). Dept. of Metallurgy). Nov 1987. Contract FG02-84ER13181. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88006286/JAW.

During the second year of the research grant, advances have been made in the following areas: (1) ex-situ DRIFT (Diffuse Reflectance) spectroscopic analysis of adsorbed oleate at the fluorite surface as a function of temperature; (2) in-situ Attenuated Total Reflectance (ATR) spectroscopic examination of adsorbed oleate at the fluorite surface; (3) electrochemical measurements for the solid electrolyte lanthanum fluoride (LaF_3)/oleate system; and (4) flotation characteristics of nonsulfide minerals with unsaturated collectors. 4 figs., 2 tabs.

22102 **(DOE/ER/45291—T1) Optical studies of dynamical processes in disordered system: Progress report, March 1987-February 1988.** Yen, W.M. (Georgia Univ., Athens (USA). Dept. of Physics and Astronomy). Jan 1988. Contract FG09-87ER45291. 16p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005965/JAW.

In this document, we present a brief summary of the progress archieved during the present grant period and an outline of the various projects currently under way including new initiatives we have undertaken. Progress has been attained in several areas: it would appear that we are nearing a complete theoretical understanding of the relaxation properties of ions in glasses as they manifest themselves in the homogeneous optical linewidth; a number of experiments currently in progress would yield definitive evidence of the validity of various theoretical predictions. Additionally, we are in the process of concluding measurements of absolute quantum efficiencies of Cr^{3+} doped transparent ceramics and extending the studies to include energy transfer processes in trivalent Nd, Cr doubly doped systems. We have obtained preliminary results in our attempts to isolate single optically active ions in a glass optical fiber.

22103 **(DOE/ER/45306—1) [Ceramic materials from preceramic organometallic copolymers]: Progress report.** (Atlanta Univ., GA (USA)). [1988]. Contract FG05-87ER45306. 8p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88006067/JAW.

The work undertaken over the last 6 months involved the synthesis of some Si-C-N homopolymers/copolymers, solution characterization of same by NMR and FT-IR spectroscopy, elemental and thermogravimetric analyses, pyrolysis under N_2 and NH_3 and product/char characterization by FT-IR spectroscopy, and preliminary thermolysis-gas chromatography/mass spectrometry experiments on model systems and some thermolysates. One, or possibly two, scientific presentations(s) will be made on the preliminary results at the ACS National Meeting in Los Angeles, California. A full manuscript is also planned for preparation over the next few months.

22104 **(DOE/ET/47927—T2) Leaching of natural and nuclear waste glasses in sea water: Progress report, CY 85, 86 and 87.** Alterescu, S. (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center). Nov 1987. Contract AI09-80ET47927. 33p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006684/JAW.

Microtektites found in sea-bed sediments provide a valuable natural analog in studies of long-term glass durability relevant to evaluation of nuclear waste glass performance. Measurements carried out on a bottle-green microtektite glass composition in de-ionized water show that this glass has relatively high leach rates as expected on the basis of its low silica content (about 50%) and high modifier content (about 20%). However, in sea water the leach rates are smaller by at least 2 orders of magnitude in agreement with the small extent of microtektite corrosion observed in nature (typically < 5 microns). Systematic studies of leachant composition effects show that the suppression of leaching in sea water is due to the presence of high levels of Mg. The leach rates of nuclear waste

borosilicate glasses are also smaller by about 2 orders of magnitude in sea water compared with their values in de-ionized water. Surface analysis of glasses exposed to sea water shows that the predominant feature is the formation of a layer which is very rich in Mg. 27 refs., 8 tabs.

22105 (INIS-SU—441, pp 35-39) **Study of radiation-induced desorption of gases out of graphite materials.** Vorob'ev, A.E.; Katrich, N.P.; Sidel'nikova, N.S.; Fedorenko, A.I. 1987. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88780051/JAW.

Voprosy Atomnoj Nauki i Tekhniki.; no. 1.

In Thermonuclear synthesis.

The study results of radiative stimulated desorption of dissolved gases and helium from GMZ and GSP graphites under irradiation by /sub 4/He/sup +/ ions (E=31 keV) at T=78 K and in backout process after iradiation (T up to 400 K) are presented in paper. It have been studied the initial samples and the samples preliminary irradiated by electrons (E=1.5 MeV) by thermal and fast neutrons and by clusters of hydrogen and helium plasmas (E10 keV). It has been shown that the desorption of impurity pases (CO, C/sub 2/H/sub 4/, N/sub 2/, H/sub 2/) is minimum for GSP samples and is of order more for GMZ samples. The all types of preliminary irradiation result in the increasing of impurity gases desorption. The activation energies for impurity gases and helium have been determined from thermodesorbtion data.

22106 (INIS-SU—443, pp 14-19) **Sound effect on annealing kinetics for implanted bihydrogen in silicon.** Bakaj, A.S.; Lazarev, N.P. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1987. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88780053/JAW.

Voprosy Atomnoj Nauki i Tekhniki.; no. 2.

In Physics of radiation damages and radiation science of materials.

Diffusion of hydrogen implanted into silicon possesses features connected with a large initial concentration of hydrogen: at first, fast diffusion runs through interstices of the crystal lattice, then, as far as the mean concentration of hydrogen decreases, the interaction with dislocations begins to play a substantial role, and diffusion slows down. Possible changes in hydrogen behaviour when powerful sound affecting the crystal are investigated.

22107 (INIS-SU—443, pp 35-37) **Thermal cycling effect on radiation resistance of epitaxial Pb/sub 1-x/Sn/sub x/Te layers under X-ray irradiation.** Pashkovskij, M.V.; Filimonenko, E.P. (L'vovskij Gosudarstvennyj Univ., Ukrainian SSR). 1987. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88780053/JAW.

Voprosy Atomnoj Nauki i Tekhniki.; no. 2.

In Physics of radiation damages and radiation science of materials.

The thermal cycling effect on resistance of epitaxial Pb/sub 1-x/Sn/sub x/Te layers with In addition under X-ray irradiation has been investigated. It is established that the amplitude of residual conductivity under X-ray quantum irradiation depends nonlinearly on the number of thermal cycles and represents a curve with the extremum, position of which depends on the current value through a sample. The results are interpreted in the framework of the representations on sub-threshold defect formation under the action of X-ray quanta.

22108 (INIS-SU—443, pp 63-64) **Radiation damage dependence on dislocation density in silicon.** Larin, R.G.; Maslov, N.I.; Neklyudov, I.M. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1987. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88780053/JAW.

Voprosy Atomnoj Nauki i Tekhniki.; no. 2.

In Physics of radiation damages and radiation science of materials.

The dependence of silicon monocrystal radiation damage efficiency on dislocation density under irradiation by 8 MeV electron pulsed beams has been investigated using the method for measuring lifetime of non-equilibrium charge carriers. It is shown that prior bending deformation of silicon monocrystals increases efficiency of silicon monocrystal radiation damage.

22109 (LA-UR—88-588) **Remarks on solid state amorphizing transformations.** Schwarz, R.B.; Johnson, W.L. (Los Alamos National Lab., NM (USA); California Inst. of Tech., Pasadena (USA). W.M. Keck Lab. of Environmental Engineering Science). 1987. Contract W-7405-ENG-36. 14p. (CONF-8708104—7). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006452/JAW.

From Conference on solid state amorphizing transformation; Los Alamos, NM, USA (10 Aug 1987).

Amorphous solids can now be produced through a variety of laboratory synthesis techniques as well as through many naturally occurring processes. In general, we can classify the methods of synthesis of amorphous solids as follows: (1) rapid solidification of melts or vapors; (2) atomic disordering of crystalline lattices; (3) solid state reactions between pure elements; (4) solid-state transformations from metastable crystalline states; and (5) deposition from electrolytes. We give a short summary of the historical development of methods (1)-(4) [method (5) is clearly outside the focus of this conference] and we discuss the basic physical principles behind the methods. 21 refs., 1 fig.

22110 (LA-UR—88-597) **Microwave sintering of alumina-SiC composites at 2.45 and 60 GHz.** Katz, J.D.; Blake, R.D.; Petrovic, J.J. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 24p. (CONF-880118—2). NTIS, PC A03. Order Number DE88006455/JAW.

From Conference on composite materials and structures; Cocoa Beach, FL, USA (20 Jan 1988).

Composites of alumina-10 vol % silicon carbide whiskers were sintered to 70% of theoretical density using both 2.45 and 60 GHz microwave radiation. Further densification was inhibited by formation of a constrained network of whiskers. Alumina-10 vol % silicon carbide platelet composites were sintered to 94% of theoretical density with 2.45 GHz microwaves in less than 20 minutes. 4 refs., 11 figs.

22111 (LBL—23600) **Fermi level stabilization in semiconductors: Implications for implant activation efficiency.** Walukiewicz, W. (Lawrence Berkeley Lab., CA (USA)). Nov 1987. Contract AC03-76SF00098. 5p. (CONF-871124—89). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88006332/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (30 Nov 1987).

We propose the existence of a Fermi level stabilization energy in III-V semiconductors which provides a reference level for the electronic part of defect annihilation energies. It is shown that the position of the stabilization energy with respect to the band edges determines the maximum free carrier concentration which can be obtained through doping. The proposed model accounts for previously unexplained trends in implant activation efficiency in III-V semiconductors. 16 refs., 3 figs.

22112 (LBL—24356) **Tungsten-carbon multilayer system studied with x-ray scattering.** Kortright, J.B.; Denlinger, J.D. (Lawrence Berkeley Lab., CA (USA)). Dec 1987. Contract AC03-76SF00098. 8p. (CONF-871124—76). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88005749/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (30 Nov 1987).

The tungsten-carbon multilayer system has been studied using x-ray scattering techniques as a function of multilayer period and annealing. Grazing incidence x-ray scattering shows that interatomic arrangements in the W-rich layers depend strongly on their proximity to the interface with the C-rich layers. Amorphous interface layers are stabilized by intermixing of W and C during deposition into local structures similar to those in the tungsten carbides. Further intermixing and structural relaxation in the amorphous state occurs on annealing these structures. This interatomic structural interpretation is consistent with trends in the observed x-ray optical properties. 7 refs., 4 figs.

22113 **(LBL—24650) Investigation of crucible materials in gradient freeze gallium arsenide crystal growth.** Hurd, J.L. (Lawrence Berkeley Lab., CA (USA)). Dec 1987. Contract AC03-76SF00098. 84p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88006333/JAW.

Undoped synthesized GaAs and crystals grown by the gradient freeze method were analyzed by room temperature Hall effect for net carrier density, secondary ion mass spectroscopy for Si and residual impurity concentrations, localized vibrational mode spectroscopy for C concentration, and optical absorption for neutral EL2 concentration. Impurity compensation was examined to determine limits for Si content in semi-insulating GaAs. Boules synthesized in various materials are used to determine the residual impurity densities contributing to compensation. Shallow donor densities below the residual acceptor concentration resulted in semi-insulating electronic properties for two synthesis boules. The Si incorporation rate in gradient freeze crystals is quantified through the deviation of net donor concentration from the normal freeze distribution. Crystals grown As-rich, Ga-rich and near-stoichiometric composition in SiO_2 crucibles show order-of-magnitude differences of Si incorporation rate. Crystals grown in Al_2O_3 and graphite crucibles have $<10^{-2}$ and >3 times the incorporation rates of gradient freeze GaAs grown in SiO_2 crucibles. Crystals grown in a vertical gradient freeze configuration have $<1/7$ the incorporation rate of those grown horizontally. A vapor mechanism for incorporation of Si is indicated that contributes enough Si to preclude semi-insulating properties. At high values of net donor density, an acceptor density is seen that may be of native defect origin and is positively correlated with net donor density. 63 refs., 16 figs., 6 tabs.

22114 **(N—88-13409) Fiber composite structural durability and damage tolerance: simplified predictive methods.** Chamis, C.C.; Ginty, C.A. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1987. 28p. (NASA-TM—100179; E—3755; NAS—1.15:100179; CONF-8704274—). NTIS, PC A03/MF A01.

From 2. symposium on composite materials: fatigue and fracture; Cincinnati, OH, USA (26 Apr 1987).

Simplified predictive methods and models (theory) to evaluate fiber/polymer-matrix composite material for determining structural durability and damage tolerance are presented and described. This theory includes equations for (1) fatigue and fracture of composites without and with defects, (2) impact resistance and residual strength after impact, (3) thermal fatigue, and (4) combined stress fatigue. Several examples are included to illustrate applications of the theory and to identify significant parameters and sensitivities. Comparisons with limited experimental data are made.

22115 **(N—88-14144) Time-temperature-stress capabilities of composite materials for advanced supersonic technology application.** Kerr, J.R.; Haskins, J.F. (General Dynamics Corp., San Diego, CA (USA)). May 1987. 675p. (NASA-CR—178272; NAS—1.26:178272; GDC-CRAD—85-005). NTIS, PC A99/MF E03.

A laboratory program was conducted to determine the time-temperature-stress capabilities of several high temperature composites. Tests included were thermal aging, environmental aging, fatigue, creep, fracture, tensile, and real-time flight simulation exposure. The program had two phases. The first included all the material property determinations and aging and simulation exposures up through 10,000 hours. The second continued these tests up to 50,000 cumulative hours. This report presents the results of the Phase 1 baseline and 10,000-hr aging and flight simulation studies, the Phase 2 50,000-hr aging studies, and the Phase 2 flight simulation tests, some of which extended to almost 40,000 hours.

22116 **(N—88-14150) Stress rupture behavior of silicon carbide coated, low modulus carbon/carbon composites.** Rozak, G.A.; Wallace, J.F. (Case Western Reserve Univ., Cleveland, OH (USA)). Jan 1988. 98p. (NASA-CR—180863; E—3708; NAS—1.26:180863). NTIS, PC A05/MF A01.

The disadvantages of carbon-carbon composites, in addition to the oxidation problem, are low thermal expansion, expensive fabrication procedures, and poor off axis properties. The background of carbon-carbon composites, their fabrication, oxidation, oxidation protection and mechanical testing in flexure are discussed.

22117 **(N—88-14151) Investigation of physical properties of thermoplastic polyimides.** Singh, J.J.; Stoakley, D.M. (National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center). Dec 1987. 13p. (NASA-TM—100530; NAS—1.15:100530). NTIS, PC A03/MF A01.

Thermoplastic polyimides are a class of promising high temperature polymers for aerospace applications. NASA-developed LARC-TPI is a prominent member of this family of polymers. Its physical characteristics have been measured as a function of its curing schedule. The results and their possible interpretations are discussed.

22118 **(N—88-14202) Mechanistic studies of polymeric samples exposed aboard STS 8.** Liang, R.H.; Gupta, A.; Chung, S.Y.; Oda, K.L. (Jet Propulsion Lab., Pasadena, CA (USA)). Dec 1987. 37p. (NASA-CR—182364; JPL-PUB—87-25; NAS—1.26:182364). NTIS, PC A03/MF A01.

The early Shuttle flights and the attendant opportunity to deploy material samples to the near-Earth space environment, along well-defined trajectories and accompanied by detailed characterization of these samples prior to and following the flight exposure, have brought to light several novel phenomena associated with interaction of these materials with the space environment. JPL, in coordination with other NASA Centers, has carried out a research program to study the degradation and oxidation processes caused by interaction of these materials with atomic oxygen at an energy of 5 eV. In addition, energetic atomic oxygen is believed to be responsible for the shuttle glow first observed during the flight of STS-3. The shuttle glow phenomenon has been extensively studied and modeled because of its long-range potential impact on optical communication schemes and its more immediate impact on the Space Telescope. This report summarizes the results of certian material degradation and erosion experiments carried out aboard STS-8 between August 30, 1983 and September 5, 1983. Based on these data, a generic degradation model has been developed for common structural polymers.

22119 **(N—88-14813) Study of some superconducting and magnetic materials on high T/sub c/ oxide superconductors. Final report, June 1985-September 1987.** Wu, M.K. (Alabama Univ., Huntsville (USA)). Oct 1987. 32p. (NASA-CR—182330; NAS—1.26:182330). NTIS, PC A03/MF A01.

On the basis of existing data it appears that the high-temperature superconductivity above 77 K reported here, occurs only in compound systems consisting of a phase other than the K_2NiF_4 phase. A narrow superconducting transition was obtained with T/sub c0/ = 98 K and T/sub c1/ = 94 K in Y-Ba-Cu-O (YBCO). Preliminary results indicate that YBCO is rather different from the layered LaBCO, LaSCO, and LaCCO. While electron-photon interaction cannot be absent from this compound system, nonconventional enhanced superconducting interactions due to interfaces, Resonating Valence Bond (RVB) states, or even a superconducting state beyond the BCS framework, may be required to account for the high T/sub c/ in YBCO. It is believed that study of the possible subtle correlation between magnetism and superconductivity will definitely provide important insight into the superconducting mechanism in YBCO and other oxides.

22120 **(PB—88-856018/XAB) Polymer radiation curing: polyolefins and acrylics. January 1970-December 1987 (citations from the NTIS data base). Report for January 1970-December 1987.** (National Technical Information Service, Springfield, VA (USA)). Jan 1988. 114p. NTIS PC N01/MF N01.

Supersedes PB—87-852463.

This bibliography contains citations concerning electromagnetic radiation curing of polyolefin and acrylic polymeric resins. Processes for crosslinking by gamma, ultraviolet, and infrared radiation are emphasized; however, microwave, laser, vacuum irradiation, and ionization radiation are examined as well. The influence of radiation induced polymer crosslinking on such properties as thermal conductivity, stress/strain, electrical conductivity, tensile and impact strength is also included. (This updated bibliography contains 231 citations, 15 of which are new entries to the previous edition.)

22121 (PB—88-856240/XAB) Plastics and elastomers: ozone degradation. January 1973-January 1988 (citations from the Rubber and Plastics Research Association data base). Report for January 1973-January 1988. (National Technical Information Service, Springfield, VA (USA)). Jan 1988. 94p. NTIS PC N01/MF N01.

Supersedes PB—87-852604.

This bibliography contains citations concerning the effects of ozone exposure on various plastics and elastomers. Polyamides, polypropylenes, polyvinyl chlorides, polystyrenes, polyethylenes, and natural and synthetic rubbers are among the plastics and elastomers tested following various concentrations of ozone exposure. Antioxidants, antiozonants, and stabilizers are also mentioned. (This updated bibliography contains 201 citations, 14 of which are new entries to the previous edition.)

22122 (PB—88-857248/XAB) Polymer radiation curing: epoxies, phenolics, fluorocarbons, and silicones. January 1970-January 1988 (citations from the NTIS data base). Report for January 1970-January 1988. (National Technical Information Service, Springfield, VA (USA)). Jan 1988. 145p. NTIS PC N01/MF N01.

Supersedes PB—87-854337.

This bibliography contains citations concerning the processes and effects of radiation curing on the following polymers: epoxy resins, phenolics, fluorocarbons, and silicones. Gamma, ultraviolet, and infrared radiation are emphasized; however, polymer crosslinking by such electromagnetic wave radiation as microwave, laser, vacuum irradiation, and ionization is included. Influence of radiation-induced polymer curing on mechanical, electrical, and chemical properties of the polymers is also included. (This updated bibliography contains 290 citations, 18 of which are new entries to the previous edition.)

22123 (PB—88-857297/XAB) Silicon nitrides. January 1970-January 1988 (citations from the US Patent data base). Report for January 1970-January 1988. (National Technical Information Service, Springfield, VA (USA)). Jan 1988. 88p. NTIS PC N01/MF N01.

Supersedes PB—87-854394.

This bibliography contains citations of selected patents concerning silicon nitride (SN) materials and their applications in industries, including the uses of SN films in semiconductor devices, cutting tools, and gas turbine components. Methods of producing protective, thermally stable, and electrically insulating SN materials by sintering and densification are discussed. Nitridation, and deposition processes of producing SN films on semiconductor substrates are disclosed. (This updated bibliography contains 182 citations, 38 of which are new entries to the previous edition.)

22124 (PNL-SA—15419) PNL-1 improved ceramic composites through controlled fiber matrix interaction. Jones, R.H.; Schoenlein, L.H.; Henager, C.H. Jr.; Schilling, C.H.; Weber, W.J.; Bates, J.L. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1987. Contract AC06-76RL01830. 30p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005680/JAW.

In summary, the micromechanical models of composite fracture clearly indicate the desirability of a high-strength reinforcement such as the Los Alamos National Laboratory (LANL) SiC whiskers. Also, the models suggest that fracture toughness increases with increasing reinforcement diameter, although this benefit cannot be realized if the properties of the reinforcement are not independent of diameter. Since the reinforcement diameter and preparation method for fibers or whiskers are interdependent, it may not be possible to independently vary the reinforcement diameter without also changing the strength. The micromechanical fracture models also indicate that fiber pullout is more effective for increasing the fracture toughness of ceramic composite than crack bridging with strong fibers or whiskers. Interface strengths of 10 to 100 MPa and 100 to 1000 MPa produce optimum fracture toughness and fracture strength properties for fiber- and whisker-reinforced composites, respectively. Optimization of the interface chemistry and structure of ceramic composites requires a clear correlation between the interface and mechanical properties. Preparations are under way to make this correlation for fracture strength, fracture toughness, fracture resistance, and environmental effects on slow crack growth. 6 refs., 14 figs., 1 tab.

22125 (SAND—87-1520C) Elastic-recoil-detection measurement of instabilities in proton-exchanged lithium niobate. Arnold, G.W.; Carnera, A.; Mazzi, G.; Mazzoldi, P. (Sandia National Labs., Albuquerque, NM (USA); Pauda Univ. (Italy). Dipartimento di Fisica). 1987. Contract AC04-76DP00789. 6p. (CONF-871124—18). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003873/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (30 Nov 1987).

The H and Li profiles in proton-exchanged (PE) $LiNbO_3$ have been measured using elastic recoil detection (ERD). Profiles were determined as a function of crystal orientation, time after PE, annealing temperature, MgO-doping, and added Li-benzoate to the benzoic acid proton source. The proton-exchange process produces H/sub x/Li/sub 1-x/NbO_3 structures where x stabilizes near values of $x \cong 0.5$ or $x \cong 0.7$ - 0.75 depending on specific conditions. The ERD measurements represent the first direct and simultaneous measurements of H- and Li-concentrations in PE $LiNbO_3$ and their variation with process parameters. 16 refs., 6 figs.

22126 (SAND—87-2846C) Photolytic deposition of InSb films. Zuhoski, S.P.; Killeen, K.P.; Biefeld, R.M. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 6p. (CONF-871124—91). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88006103/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (30 Nov 1987).

Films of InSb were deposited on GaAs <100> substrates at room temperature by excimer laser photolysis at 193 or 248 nm of a mixture of trimethylindium (TMIn) and trimethylantimony (TMSb) in a hydrogen carrier medium. These films were compared to thermally grown MOCVD (metalorganic chemical vapor deposition) InSb films by optical microscopy and x-ray analysis and found to be stoichiometric polycrystalline, InSb. In-situ uv absorption spectroscopy has been used for the first time on an MOCVD system to monitor and control the partial pressures of the metalorganic reactants during deposition. This latter diagnostic was found to be critically important since parasitic reactions cause depletion of TMIn during transport from the source bubbler to the growth chamber. 6 figs.

22127 (SAND—87-3065C) A three-dimensional model for the elastic properties of a foam. Warren, W.E.; Kraynik, A.M. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 5p. (CONF-880475—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88006197/JAW.

From 7. international conference on deformation, yield, and fracture of polymers; Cambridge, UK (11 Apr 1988).

A strain energy function that describes the nonlinear elastic response of a 3-D open-cell foam is developed. A tetrahedral unit cell containing four half-struts that join at equal angles represents essential features of foam microstructure. The deformation of a strut is expressed by compliances for bending and stretching, which are the primary mechanisms for small and large distortion, respectively, of a low-density foam. Higher-order contributions to the strain energy are determined by assuming that the structure is effectively pin jointed. 2 figs.

22128 (UCID—21340) Computing x-ray effects in optics. Rhoades, C.E. Jr. (Lawrence Livermore National Lab., CA (USA)). 5 Feb 1988. Contract W-7405-ENG-48. 16p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006722/JAW.

In this paper, we discuss the physical phenomena that are important in understanding the behavior of optics exposed to X-ray fluences, and four computer programs that are commonly used to perform such calculations. We describe several model problems and spectra that we used to exercise the four computer codes. Finally, we close with a number of conclusions and recommendations for those who wish to use one or more of the codes to predict the response of optics to X-ray fluences. In particular, we find that multi-

dimensional geometry issues must be carefully addressed and special care must be taken to insure that even the one dimensional calculations have converged. 3 refs., 11 figs.

22129 **X-ray scattering studies of the Si-SiO_2 interface.** Fuoss, P.H.; Norton, L.J.; Brennan, S.; Fischer-Colbrie, A. (AT&T Bell Laboratories, Holmdel, New Jersey 07733). *Physical Review Letters;* **60**: No. 7, 600-603(15 Feb 1988).

We report observation of microcrystalline interface phases at the SiO_2-Si(001) interface. The crystallites have varying degrees of orientational order with respect to the substrate depending on preparation techniques. Most of the diffraction peaks from these phases can be indexed as due to the α-cristobalite structure. Data are presented for oxides prepared on Si(001) surfaces by thermal oxidation, by electron beam evaporation, and by native oxide formation.

22130 **Anisotropic packing and diffraction-peak shifts in icosahedral glasses.** Goldman, A.I.; Stephens, P.W. (Department of Physics, Brookhaven National Laboratory, Upton, New York 11973). *Physical Review [Section] B: Condensed Matter;* **37**: No. 6, 2826-2828(15 Feb 1988). Contract AC02-76CH00016.

We show that the anisotropic random packing of units with icosahedral symmetry produces diffraction patterns with distortions similar to recent electron and x-ray diffraction measurements. Using the Hendricks-Teller formalism discussed in an earlier paper, we show that the peak shifts predicted by the introduction of phason strain in an ideal quasilattice may also be described by this anisotropic, random-packing, icosahedral glass model.

22131 **Nonlocality in the density-functional description of bonding in Li_2, N_2, O_2, and F_2.** Kutzler, F.W.; Painter, G.S. (Department of Chemistry, Tennessee Technological University, Cookeville, Tennessee 38505). *Physical Review [Section] B: Condensed Matter;* **37**: No. 6, 2850-2854(15 Feb 1988).

The fully self-consistent implementation of the nonlocal-density functional of Langreth and Mehl has been used in conjunction with the augmented Gaussian method to calculate the potential-energy curves and dissociation energies of N_2, Li_2, O_2, and F_2. The nonlocal functional gives ground-state potential-energy curves in very good agreement with experiment. We compare these nonlocal results with other local-density calculations, and examine the effect of nonlocal-potential self-consistency on the dissociation energy.

22132 **Monitoring the surface oxidation process with an energy-tunable monoenergetic positron beam.** Chen, Y.; Lynn, K.G.; Nielsen, B. (Brookhaven National Laboratory, Upton, New York 11973). *Physical Review [Section] B: Condensed Matter;* **37**: No. 6, 3105-3108(15 Feb 1988).

Monoenergetic positrons with incident energies of less than 25 eV were employed as a nondestructive surface and near-surface sensitive probe. Positron reflectivity and the positronium emission were measured as a function of incident energy for various oxygen coverages ranging from submonolayer to 3500 A of SiO_2 on Si. The characteristics of these spectra change systematically with oxidation and are in good agreement with the known development of the surface electronic structure. Different oxidation stages are identified.

22133 **Optical constants for thin films of C, diamond, Al, Si, and CVD SiC from 24 A to 1216 A.** Windt, D.L.; Cash W.C. Jr.; Scott, M.; Arendt, P.; Newnam, B.; Fisher, R.F.; Swartzlander, A.B.; Takacs, P.Z.; Pinneo, J.M. (University of Colorado, Center for Astrophysics & Space Astronomy, Boulder, Colorado 80309). *Applied Optics;* **27**: No. 2, 279-295(15 Jan 1988).

A method for deriving optical constants from reflectance vs angle of incidence measurements using a nonlinear least-squares curve-fitting technique based on the chi^2-test of fit is presented and used to derive optical constants for several thin-film materials. The curve-fitting technique incorporates independently measured values for the film surface roughness, film thickness, and incident beam polarization. The technique also provides a direct method for estimating probable errors in the derived optica constants. Data are presented from 24 A to 1216 A for thin-film samples of C, synthetic diamond, Al, Si, and CVD SiC. AUger electron spectroscopy depth profiling measurements were performed on some of the samples to characterize sample composition including oxidation and contamination.

22134 **Soft-phonon behavior and transport in single-crystal La_2CuO_4.** Birgeneau, R.J.; Chen, C.Y.; Gabbe, D.R.; Jenssen, H.P.; Kastner, M.A.; Peters, C.J.; Picone, P.J.; Thio, T.; Thurston, T.R.; Tuller, H.L.; and others. (Center for Materials Science and Engineering, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Physical Review Letters;* **59**: No. 12, 1329-1332(21 Sep 1987).

Using a flux technique we have grown sizable single crystals of La/sub 2-//sub x/Sr/sub x/CuO_4. With x rays and neutrons we have studied both the static and dynamic aspects of the tetragonal to orthorhombic structural phase transition; classic soft-phonon behavior is observed at the ((1/2, 1) / 2 , 0) zone boundary involving rotations of CuO_6 octahedra. The pure and lightly-doped single crystals show hopping conductivity, lnrho~(T_0/T)/sup 1/4/, indicating that the electronic states at the Fermi energy are localized.

22135 **Differences in the band electronic structures of the tetragonal orthorhombic phases of the high-temperature superconductor YBa_2Cu_3O/sub 7-y/(T/sub c/ > 90 K).** Whangbo, M.H.; Evain, M.; Beno, M.A.; Geiser, U.; Williams, J.M. (North Carolina State Univ., Raleigh). *Inorganic Chemistry;* **26**: No. 16, 2568(12 Aug 1987). Contract FG05-86ER45259;W-31-109-ENG-38.

The previously reported work on the structure of YBa_2Cu_3O/sub 7-y/ was reviewed. In the work reported herein, the electronic structure of the tetragonal compound YBa_2Cu_3O/sub 7-y/ was examined by performing tight-binding band calculations on two ordered model structures designed to simulate the tetragonal YBa_2Cu_3O/sub 7-y/ phase. Analysis of how the tetragonal and orthorhombic phases differ in their electronic structures was performed. It was concluded that the presence of CuO_3 chains essential for the occurrence of high superconductivity transition temperature, T/sub c/ > 90K in the orthorhombic phase of YBa_2Cu_3O/sub 7-y/. 29 references, 2 figures.

22136 **The preferred habit of a coherent thin-plate inclusion in an anisotropic elastic solid.** Kostlan, E.; Morris, J.W. Jr. (Mathematical Sciences Research Institute and Center for Advanced Materials, Lawrence Berkeley Lab., and Dept. of Materials Science and Mineral Engineering, Univ. of California, Berkeley, CA 94720). *Acta Metallurgica;* **35**: No. 8, 2167(Aug 1987). Contract AC03-76SF00098.

The work reported here was undertaken to find algebraic equations for the preferred habits of coherent thin-plate inclusions in anisotropic media on the assumption that the inclusion and matrix can be treated as linear elastic continua. The preferred habit minimizes the elastic energy, which depends on the elastic constants of the inclusion and the transformation strain connecting the lattices of the inclusion and the matrix. The paper presents four principal results concerning the preferred thin-plate habit. First the mathematical conditions that determine the preferred habit are derived in compact form. These conditions are always satisfied when the transformation strain is dyadic and the habit is perpendicular to a vector of the dyad, reproducing a result that is given by Khatchaturyan and included in the crystallographic theory of precipitate habits. The extremal conditions are solved for orthorhombic symmetry, that is, when the elastic constants of the inclusion have orthorhombic symmetry with respect to the principal axes of the transformation stress. The results incorporate isotropic, cubic, hexagonal and tetragonal (type II) symmetries. They are specialized to determine the minimum-energy habit as a function of the transformation strain for three classes of inclusions: isotropic inclusions, cubic inclusions with tetragonal transformation strains, and hexagonal inclusions with hexagonal transformation strains. Finally it is shown by counter-example that there is no general algebraic solution for systems of arbitrary symmetry.

22137 **Simulations of grain impingement and recrystallization kinetics.** Price, C.W. (Chemistry and Materials Science Dept., Lawrence Livermore National Lab., Univ. of California, Livermore, CA 94550). *Acta Metallurgica;* **35**: No. 6, 1377-1390(Jun 1987). Contract W-7405-ENG-48.

A simplified computer model based on regular distributions of geometric grains was used to simulate grain impingement that occurs during recrystallization reactions. The model assumes instantaneous nucleation with all grains growing at the same rate. Impingement geometry was studied as a function of grain shape, grain symmetry, and distribution geometry. Kinetic recrystallization plots were generated from the geometric-impingement data by relating the radius or size parameter of the grain to an appropriate time scale. These kinetic simulations permitted analysis of existing kinetic models and isolated some critical limitations of the models.

22138 **Silicon particle growth in a fluidized-bed reactor.** Hsu, G.; Rohatgi, N.; Houseman, J. (Jet Propulsion Lab., California Institute of Technology, Pasadena, CA 91109). *A.I.Ch.E. Journal (New York);* **33**: No. 5, 784-791(May 1987).

This paper describes the overall operation of a 15 cm dia. fluidized-bed reactor for silicon production via silane pyrolysis. The fluidized bed reactor has been characterized by its performance data and parametric effects. A withdrawal system is used to selectively remove big particles. Seed generation is provided by a fluid jet milling device, which avoids metallic grinding contamination. The silicon particle size growth calculated from a scavenging/deposition model agrees with actual size measurements.

22139 **Morphological stability of continuous intergranular phases: Thermodynamic considerations.** Carter, W.C.; Glaeser, A.M. (Dept. of Materials Science and Mineral Engineering, and Materials and Molecular Research Div., Lawrence Berkeley Lab., Univ. of California, Berkeley, CA 94720). *Acta Metallurgica;* **35**: No. 1, 237-246(Jan 1987). Contract AC03-76SF00098.

A thermodynamic analysis of the morphological stability of continuous intergranular phases, incorporating the number of bounding grains n, and dihedral angle Psi as variables is presented. For each n, the minimum thermodynamically unstable wavelength of an infinitesimal amplitude perturbation coincides with the Rayleigh result (2πR/sub c/) for Psi = 180° For n = 2, the ratio λ/sub min//2πR/sub c/ decreases with Psi, approaching a limit of (0.7)/sup 1/2/ as Psi$\rightarrow$0°. For n$\geq$3, λ/sub min//2πR/sub c/ increases with decreasing Psi and tends to infinity as Psi$\rightarrow\pi$ - (2π/n), or equivalently as the interface curvature vanishes. For fixed Psi, the stability increases with n. Several applications and implications of the analysis are discussed.

22140 **Investigations of low-temperature epitaxy, ion damage, and reactive-ion cleaning utilizing ion beam deposition.** Appleton, B.R.; Zuhr, R.A.; Noggle, T.S.; Herbots, N.; Pennycock, S.J. (Solid State Div., Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN 37831). pp 45-58 of Beam-solid interactions and transient processes. Thompson, M.O.; Picraux, S.T.; Williams, J.S. Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—). Contract AC05-84OR21400.

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

The technique of ion beam deposition (IBD) is utilized to investigate low-energy, ion-induced damage on Si and Ge; to study reactive ion cleaning of Si and Ge; to fabricate amorphous isotopic heterostructures; and to fabricate and study the low-temperature epitaxial deposition of /sup 74/Ge on Ge(100), /sup 30/Si on Si(100), and /sup 74/Ge on Si(100). The techniques of ion scattering/channeling and cross-sectional TEM are combined to characterize the deposits.

22141 **Characterization and evolution of microstructures formed by high dose oxygen implantation of silicon.** El-Ghor, M.K.; Pennycook, S.J.; Sjoreen, T.P.; Narayan, J. (Solid State Div., Oak Ridge National Lab., Oak Ridge, TN 37831). pp 591-596 of Beam-solid interactions and transient processes. Thompson, M.O.; Picraux, S.T.; Williams, J.S. Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—). Contract AC05-84OR21400.

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

High doses of oxygen were implanted in silicon to produce stoichiometric buried oxide structures. Microstructural analysis was performed using transmission electron microscopy, electron energy loss spectroscopy, and Rutherford backscattering/channeling techniques. Cavities were observed in the top silicon layers of the as-implanted samples in two forms: spherical cavities (30-300A in diameter) in the first 1000 A below the surface, followed by a 500 A wide lamellar array of elongated cavities. A post implantation annealing was carried out at temperatures between 1150°C and 1250°C for 3 h during which the cavities became faceted and a denuded zone of 400 A was formed. However, with a 1300°C anneal the cavities disappeared and the density of the two prominent types of defects, namely precipitates (mostly amorphous, but occasionally crystalline) and dislocations, decreased significantly. The silicon-oxide interface became increasingly planar. Possible mechanisms of annealing of the cavities, the precipitates, and the associated planarization of the interface are proposed.

22142 **Transient enhanced diffusion in B/sup +/ and P/sup +/ implanted silicon.** Pennycock, S.J.; Culbertson, R.J. (Solid State Div., Oak Ridge National Lab., Oak Ridge, TN 37831). pp 379-384 of Beam-solid interactions and transient processes. Thompson, M.O.; Picraux, S.T.; Williams, J.S. Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—). Contract AC05-84OR21400.

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

The authors report the transient enhanced diffusion of supersaturated phosphorous in ion-implanted SPE grown Si. Precipitation proceeds rapidly to a metastable SiP phase, which can be converted to an orthorhombic form or re-dissolved by subsequent heat treatment. The effects are strongly temperature dependent, and consistent with the trapped interstitial model. The behavior of different dopants follow their relative interstitialcy diffusion coefficients. The results suggest that ion implantation induced point defects dominate over thermally activated point defects during low temperature and certain rapid thermal processing, controlling dopant deactiviation and diffusion in crystalline or amorphous silicon, and can also affect the SPE growth rate.

22143 **Formation of stable point defects in ion-implanted Si.** Culbertson, R.J.; Pennycock, S.J. (Solid State Div., Oak Ridge National Lab., Oak Ridge, TN 37831). pp 391-398 of Beam-solid interactions and transient processes. Thompson, M.O.; Picraux, S.T.; Williams, J.S. Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—). Contract AC05-84OR21400.

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

Double doping of Si by ion implantation of both group V and group III dopants was studied. For the case of Sb ad the group V dopant, both Sb and B could be maintained in solution after high temperature heat treatment at concentrations greatly exceeding their solubility limits. With Sb implantation alone, Sb diffusion takes place with a highly enhanced transient diffusion, followed by nucleation of self interstitials into loops at the projected range. In certain double-doped samples this projected range damage was eliminated. In the under-compensated B-Sb case, evidence of stable Sb-B pairs was obtained.

22144 **Investigations of the electrical neutralization and bonding mechanisms of shallow impurities in silicon grain boundaries.** Kazmerski, L.L.; Nelson, A.J.; Dhere, R.G.; Abou-Elfotouh, F. (Solar Energy Research Institute, Golden, CO 80401). pp 944-950 of Nineteenth IEEE photovoltaic specialists conference, 1987. (Conference Record). Piscataway, NJ; IEEE Service Center (1987). (CONF-870528—). Contract AC02-83CH10093.

From 19. IEEE photovoltaic specialists conference; New Orleans, LA, USA (4 May 1987).

Interactions between shallow acceptors (B, Al, Ga and In) and hydrogen in polycrystalline Si are investigated. The bonding mechanisms involved in the acceptor neutralization process at grain boundaries are examined using microanalytical techniques. Differences in the incorporation of molecular and atomic hydrogen, and corresponding variations in electrical passivation at grain boundaries, are observed. Low-temperature Auger difference spectroscopy confirms Si-H bonding to dominate B, Ga and In-doped cases, with no direct acceptor-hydrogen bonding. Al-rich grain boundaries show H-complex and hydroxyl bonding. The data confirm chemical bond strength trends with B<Ga<In. Volume-indexed AES is utilized to compare bonding and H-distributions in B- and Al-rich grain boundary regions.

22145 **Minority-carrier properties of 1.93-eV Al/sub 0.37/Ga/sub 0.63/As grown by MOCVD.** Ahrenkiel, R.K.; Greenberg, D.; Dunlavy, D.J.; Hanak, T.; Schlumpmann, J.; Hamaker, H.C.; Lewis, C.R. (Solar Energy Research Institute, Golden, CO 80401). pp 1180-1186 of Nineteenth IEEE photovoltaic specialists conference, 1987. (Conference Record). Piscataway, NJ; IEEE Service Center (1987). (CONF-870528—). Contract AC02-83CH10093.

From 19. IEEE photovoltaic specialists conference; New Orleans, LA, USA (4 May 1987).

The minority-carrier lifetimes, mobilities, and diffusion lengths have been measured in MOCVD Al/sub 0.37/Ga/sub 0.63/As by several experimental techniques. These measurements were made on devices with both p- and n-type active regions. The minority-carrier electron mobilities were comparable to majority-carrier mobilities in similarly doped material. Lifetimes of 7 to 11 ns were observed at doping levels about 10/sup 17/ cm/sup -3/. Diffusion lengths exceeding 2 μm were observed in the same material.

22146 **Crystal growth and photoelectrical properties of Cu/sub x/Ag/sub 1-x/InSe/sub 2/ and CuIn/sub y/Ga/sub 1-y/Se/sub 2/ solid solutions.** Ciszek, T.F.; Bacewicz, R.; Durrant, J.R.; Deb, S.K.; Dunlavy, D. (Solar Energy Research Institute, Golden, CO 80401). pp 1448-1453 of Nineteenth IEEE photovoltaic specialists conference, 1987. (Conference Record). Piscataway, NJ; IEEE Service Center (1987). (CONF-870528—).

From 19. IEEE photovoltaic specialists conference; New Orleans, LA, USA (4 May 1987).

A light-encapsulated Bridgman/Stockbarger method was used to grow solid-solution crystals of Cu/sub x/Ag/sub 1-x/InSe/sub 2/ and CuIn/sub y/Ga/sub 1-y/Se/sub 2/ after in situ synthesis from the elements. Values of x and y equal to approximately 0, 0.25, 0.5, 0.75, 0.9, and 1.0 were used for the elemental starting compositions. From x-ray diffraction spectra, the lattice constants a and c of the tetragonal unit cell were determined. It was observed that c/a ratios near 2.0 yielded the best crystals. Optical absorption, photoconductivity, and photoluminescence were studied. The band-gap values were estimated. A number of defect states active in photoconductivity and photoluminescence were found, and assignment of these states to native defects present in the alloys is suggested.

22147 **A small angle neutron scattering study on a polymer blend: Characterization of the deformation behaviour.** Porter, R.S.; Wignall, D.; Lefebvre, J.M. (National Center for Small Angle Scattering Research, Oak-Ridge National Lab., Oak-Ridge, TN 37831). pp 500-502 of ANTEC '86: Plastic-value through technology. Brookfield Center, CT; Society of Plastic Engineers (1986). (CONF-8604120—).

From American Society of Plastics Engineers conference; Boston, MA, USA (28 Apr 1986).

Among the various techniques developed to characterize the structure of polymer blends, Small Angle Neutron Scattering (S.A.N.S.) has received considerable attention over the past few years. By using S.A.N.S. it is possible to determine the conformation of the polymer chain as well as the interaction parameter between the components of the blend. Based on relative solubility considerations, compatability of P.M.M.A. and P.E.O. in the melt has been theoretically predicted and subsequently verified. Among recent studies on the crystallization of P.E.O. in this binary blend, a spectroscopic and calorimetric investigation in the laboratory revealed the totally amorphous character of the blend for P.E.O. content below 20%. The authors focused their interest on this low P.E.O. concentration domain, namely a system P.M.M.A./P.E.O. - 90/10% by weight to compare the deformation behaviour of the amorphous blend to that of the pure P.M.M.A.

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4001 Analytical And Separations Chemistry

REFER ALSO TO CITATION(S) 20791, 20993, 20993, 20995, 20995, 21052, 21082, 21958, 22146, 22147, 22223, 22512, 22513, 22514, 22515, 22516, 22517, 22518, 22854, 22855, 22886, 23224, 23975

22148 **(AD-A—187178/9/XAB) Californium-252 plasma desorption with Fourier-transform mass spectrometry. Report for 1 January 1930-June 1987.** Loo, J.A.; Williams, E.R.; Amster, I.J.; Furlong, J.J.; Wang, B.H. (Cornell Univ., Ithaca, NY (USA). Baker Lab.). 15 Jul 1987. 5p. NTIS, PC A02/MF A01.

Pub. in Analytical Chemistry, Vol. 59, No. 14, 1880-1882(15 Jul 1987).

Plasma desorption (PD) using ^{252}CF produces analytically useful Fourier-transform (FT) mass spectra from compounds of molecular weights to 2000. In direct comparison to PD spectra measured conventionally on time-of-flight instruments, PD-FT spectra have much higher resolution and useful fragment-ion information, but have higher backgrounds and orders-of-magnitude lower ion-collection efficiencies. Signal levels have been improved substantially by depositing the sample with glutathione or on nitrocellulose, by repeated (1-2 minutes) spectral measurements during ion production without ion quenching, and by separate optimization of the potential on the sample holder and trapping plates.

22149 **(ENEA-RT-COMB—85-1) Determination of uranium, thorium and radium 226 in zircon containig sands by alpha spectrometry.** Spezzano, P. (ENEA, Rome (Italy)). 1985. 35p. (In Italian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700981/JAW.

The industrial utilization of zircon sands for the production of refractories presents radiological problems owing to the risk of inhalation of uranium, thorium and their decay products, present in high concentrations in such materials. A method of analysis was realized for the determination of uranium, thorium and radium-226 in zircon sands, including the total dissolution of the sample, radiochemical separation and final measurement by alpha spectrometry with surface barrier detector. The concentrations of the main alpha-emitting radionuclides presents in two samples of zircon sands have been determined and the possibility of disequilibrium along the decay series has been pointed out. 30 refs.

22150 **(EUR—10297) Certification of hydrogen in titanium. CRM No. 318.** Vandendriessche, S.; Marchandise, H.; Vandecasteele, C. (Commission of the European Communities, Luxembourg). 1987. 16p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88752115/JAW.

This report describes the work done to certify the hydrogen content in a batch of 28 kg of commercial unalloyed titanium. The homogeneity of the three original sheets of metals was demonstrated. Samples were analysed by 10 laboratories using hydrogen extraction and thermal conductivity measurement and by 2 laboratories using a nuclear resonance reaction technique, but the accuracy of the latter was insufficient for a certification. On the basis of the measurements in 8 laboratories using extraction techniques, the hydrogen mass fraction in the titanium (CRM 318) is certified to be (12.2 +/- 0.8) ug/g.

22151 **(IAEA-LAB—243) Analytical quality control service programme, intercomparison runs, certified reference materials, reference materials 1987-1988.** (International Atomic Energy Agency, Vienna (Austria)). Dec 1986. vp. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701040/JAW.

Also published in French, Russian and Spanish.

The purpose of the Analytical Quality Control Services (AQCS) programme provided by the IAEA, is to assist laboratories engaged in the analysis of nuclear, environmental, biological, and materials of marine origin for radionuclide, major, minor and trace elements, as well as stable isotopes using atomic and nuclear analytical techniques, to check the quality of their work. The tables give details of the intercomparison samples and reference materials distributed by the IAEA in the period 1987 to 1988. 2 tabs.

22152 **(IAEA-R—3482-F) Correlation studies between the results of workplace monitoring and biological parameters. Final report for the period June 1983 - June 1986.** Khan, A.H. (Atomic Energy Centre, Dhaka (Bangladesh). Trace Analysis Lab.). (International Atomic Energy Agency, Vienna (Austria)). Oct 1987. 28p. NTIS (US Sales Only), PC A03/MF A01. Order Number TI88701737/JAW.

Some nuclear-based and non-nuclear analytical techniques have been used to look for correlations between the results of workplace monitoring and biological parameters of exposed workers in various workplace environments. The analytical competence of the external beam thick and thin target particle-induced X-ray emission (PIXE) analysis has been established for elemental analysis of air particulates and biological materials. The capability of low-energy photon spectrometry (LEPS) has also been demonstrated. Using the methods of PIXE and flame AAS, some studies have been performed on the elemental composition of air particulates, human head hair, nail and urine collected in different workplace environments in Dhaka. This report contains a brief account of this research along with an outline of future research projects to be carried out in this and other related areas. 13 refs, 5 figs, 7 tabs.

22153 **(INIS-BR—954) Effect of pre-dose irradiation in the quartz and its use for archaelogical dating.** Yukimitu, K. (Sao Paulo Univ. (Brazil). Inst. de Fisica). 1985. 81p. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. Order Number TI88701608/JAW.

The technique of pre-dose for dating ceramics, using the thermoluminescent properties of quartz is presented. The behavior of thermoluminescent (TL) sensitivity of the 110/sup 0/C peak of Brazilian quartz, in its geologic state, submitted to thermal treatments from 600 to 900/sup 0/C, is studied. The samples were tritured for separating the quartz crystals from clay. The quartz grains were submitted to leaching with chloric acid solution followed by leaching with running water. The samples were irradiated in laboratory, with gamma radiation using Co-60 and Cs-137 sources, for calibration. A sensitivity enhancement rate of 2% per rad was observed for samples annealed at 900/sup 0/C, was observed. (M.C.K.).

22154 **(INIS-BR—956) Biogeochemical and micropaleontological study of black chert, Sete Lagoas Formation, Bambui Group (Late Proterozoic), Sao Gabriel (GO), Brazil.** Subacius, S.M.R. (Sao Paulo Univ. (Brazil). Inst. de Geociencias). 1985. 164p. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. Order Number TI88701610/JAW.

The biogeochemical study of amorphous and structured organic matter (OM) in two samples of thinly laminated black cherts (SG-1 and SG-2) from Sete Lagoas Formation, State of Goias, Brazil, is presented. The spectra analysis of infra-red, electron paramagnetic resonance and isotope ratio of C-12 and C-13 shown that: the amorphous OM consists of a soluble fraction (SF) and a insoluble fraction (Kerogen), which only the latter is syngenetic; the allochthonous SF comes from several sources, mainly from Phanerozoic sediments and soil contamination; the SG-1 and SG-2 Kerogens have δ /sup 13/C values (-27.2 per mille and - 29.2 per mille respectively), which suggest OM photosynthetized and submitted to a mild thermal hystory; although the preserved microbiota is dominated by allochthonous elements (colonial fragments) and planktonic forms, both Kerogens were derived for the most part from photo-autotrophic benthonic communities, probably responsible for the lamination in the original carbonate rock, both SG-1 and SG-2 Kerogens exhibits O/C and H/C ratios comparable to Proterozoic humic Kerogens (type IV); the preserved microflora represents a microbial community of the chert-algae facies typical of the Middle and upper Proterozoic; and the occurence of rare acritarchs (Kildinella spp.) in the microflora is biostratigraphically significant in that it suggests a Late Riphean or Vendian age (950-570 m.y.) for the Sete Lagoas Formation.

22155 **(INIS-BR—958) Application of carbon and oxygen stable isotopes to the study of Brazilian precambrian.** Torquato, J.R.F. (Ceara Univ., Fortaleza (Brazil). Dept. de Geologia). 1980. 276p. (In Portuguese). NTIS (US Sales Only), PC A13/MF A01. Order Number TI88701612/JAW.

Samples of carbonated rocks of precambrian age are studied. The stable carbon and oxygen isotopes are applied to the study of terrestrial materials considering the variations of some element isotopic composition in function of the environment of sedimentation. The isotopic analysis was done using mass spectrometers. The analytical results and the description of region geology of the site of each sample are presented. The isotopic data are interpreted aiming to the environment of sedimentation. New techniques for better improvement of carbon and oxygen ratios, are proposed, such as: to use the analysis of surface trend and the isotopic logging in mapping of surface and subsurface. A new method for approximated determination of the ages of precambrian carbonated rocks, considering the limitations of their new technique, is also presented. (M.C.K.).

22156 **(INIS-GB—120) NERC radiocarbon dating: 1975-1985. A review of the contribution to quaternary research by the NERC Radiocarbon Dating Laboratory over the last decade.** Bowen, D.Q.; Harkness, D.D. (Natural Environment Research Council, London (UK)). Jun 1986. 49p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752360/JAW.

The paper reviews the work of the Natural Environment Research Council Radiocarbon Dating Laboratory in connection with Quaternary research, over the last decade. A description is given of the development of the dating service and in-house research. Quaternary research investigations aided by radiocarbon dating are described under the topic headings: The late Devensian glacial maximum, late glacial, middle Devensian, palaeomagnetic secular variation in lake sediments, vegetational history, faunal history, palaeolimnology, ground water, volcanology, periglacial research, palaeohydrology, geomorphology, quaternary events in low-latitudes, environmental archaeology, archaeology, deep sea sediments, continental shelf, coastal geomorphology, and radiocarbon dating in Antarctica. (U.K.).

22157 (INIS-mf—10846, pp 38) **Direct atomic emission analysis of trace elements in blood serum and organ tissues.** Marinov, M.I. (Meditsinska Akademiya, Sofia, Bulgaria). Nov 1984. (In Bulgarian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

22158 (INIS-mf—10846, pp 54) **Gamma-spectroscopy of plutonium isotope ratio determination using weighted linear regression model.** Petkov, T.; Badulin, V. (Meditsinska Akademiya, Sofia, Bulgaria). Nov 1984. (In Bulgarian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

22159 (JINR—R-7-86-322, pp 32) **Noble metals concentration method for geologic sample analysis.** Zhujkov, B.L.; Popeko, G.S.; Ortega, Kh.D. 1986. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780065/JAW.

In Heavy ion physics - 1985. Collection of annotations of the Nuclear Reaction Laboratory of the Joint Nuclear Research Institute works, 1985.

22160 (JINR—R-7-86-322, pp 79) **Instrumental neutron activation analysis of ores and ore processing products using antimony-beryllium neutron source.** Gerbin, Sh.; Leonard, M.; Kezhek, I.; Sodnom, N. 1986. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780065/JAW.

In Heavy ion physics - 1985. Collection of annotations of the Nuclear Reaction Laboratory of the Joint Nuclear Research Institute works, 1985.

22161 (JINR—R-7-86-322, pp 80) **Instrumental neutron activation method for iridium determination.** Flerov, G.N.; Popeko, G.S.; Ter-Akop'yan, G.M. 1986. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780065/JAW.

In Heavy ion physics - 1985. Collection of annotations of the Nuclear Reaction Laboratory of the Joint Nuclear Research Institute works, 1985.

22162 (JINR—R-7-86-322, pp 81) **Application of α-source /sup 210/Po for analysis of light elements (aluminium, fluorine, nitrogen).** Fam Ngok Chyong; Ter-Akop'yan, G.M.; Fam Van An; Ivanov, M.P. 1986. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780065/JAW.

In Heavy ion physics - 1985. Collection of annotations of the Nuclear Reaction Laboratory of the Joint Nuclear Research Institute works, 1985.

22163 (JINR—R-7-86-322, pp 82) **Method for beryllium determination by (α,n) reaction.** Fam Ngok Chyong; Ter-Akop'yan, G.M.; Kabachenko, A.P. 1986. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780065/JAW.

In Heavy ion physics - 1985. Collection of annotations of the Nuclear Reaction Laboratory of the Joint Nuclear Research Institute works, 1985.

22164 (JINR—R-7-86-322, pp 83) **Reaction /sup 10/Be(p,n) with proton energy < 2MeV. Possible method of /sup 10/Be determination.** Ter-Akop'yan, G.M.; Fam Ngok Chyong; Eremin, N.V.; Strizhov, V.F.; Kabachenko, A.P.; Chelnokov, L.P. 1986. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780065/JAW.

In Heavy ion physics - 1985. Collection of annotations of the Nuclear Reaction Laboratory of the Joint Nuclear Research Institute works, 1985.

22165 (LBL—24049) **The contribution of electron microscopy of materials science to society.** Thomas, G. (Lawrence Berkeley Lab., CA (USA)). Aug 1987. Contract AC03-76SF00098. 26p. (CONF-8709239—1). NTIS, PC A03. Order Number DE88006341/JAW.

From Philips symposium; Eindhoven, Netherlands (24 Sep 1987).

The examples discussed are just a few of very many that could be used to illustrate the impact of electron microscopy in materials upon society. Electron microscopy, materials science and engineering represent classic examples of demanding and interdisciplinary team efforts. While in its early days, electron microscopy was mainly used as a sort of forensic tool to understand existing problems, it is now becoming more and more used in the development and design of new or improved materials required for advanced sytems - to conserve energy and new or improved materials required for advanced systems - to conserve energy and materials. Over a century ago, H.C. Sorby was the first scientist to develop the use of thin sections of minerals for optical microscopy. Today we use 1000 times thinner sections in order to resolve the atomic arrangements in powerful electron microscopes, at the surfaces, interfaces and inside crystal grains. Materials science and engineering cannot progress without the electron microscope. 19 figs., 3 tabs.

22166 (NIIAR—12(658)) **Metrological certification of mass-spectrometric methods for measurement of isotope composition and mass of uranium, plutonium, americium, curium, californium.** Vakhturov, A.N.; Gabeskiriya, V.Ya.; Inchagov, A.V.; Leont'ev, N.P.; Chernov, A.V.; Chetverikov, A.P. (Nauchno-Issledovatel'skij Inst. Atomnykh Reaktorov, Dimitrovgrad (USSR)). 1985. 14p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701210/JAW.

Metrological certification of mass-spectrometric methods for measurement of isotope composition of uranium, plutonium, americium, curium and californium, as well as determination of microgram quantities of plutonium and americium using isotope dilution is carried out. Factors influencing on analysis errors are investigated. Certification is carried out using standard samples of uranium and certified plutonium solutions. Depending on mole isotope fraction, relative mean square deviation of observation results is shown to change from 0.004 to 0.020, and the relative value of the confidence limits of non-exceptional systematic error - from 0.007 to 0.012. The systematic error (0.0039 +- 0.0012 per an atomic mass unit) caused by ion discrimination in mass-spectrometers MI-1311 and MI-1305 with a secondary electron multiplier is determined. Confidence limits of errors have been determined with 0.95 probability. 9 refs.; 3 tabs.

22167 (RISO-M—2658) **Survey of archaeological samples dated in 1986.** Mejdahl, V. (Risoe National Lab., Roskilde (Denmark)). Oct 1987. 31p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752052/JAW.

A survey is given of archaeological samples dated in 1986 at the Nordic Laboratory for Thermoluminescence Dating. A total of 56 samples were dated. The results were corrected for shortterm fading measured for samples stored for four weeks at room temperature or at 100 deg. C. The beta dose from potassium and rubidium in feldspar an the alpha dose from uranium and thorium in quartz and feldspar grain were included assuming alpha efficiency factors of 0.1 and 0.2 for quartz and feldspar, respectively. 21 refs.

22168 (RISO-M—2671) **Determination of technetium-99 in environmental samples by solvent extraction at controlled valence.** Qingjiang Chen; Aarkrog, A.; Dick, H.; Mandrup, K. (Risoe National Lab., Roskilde (Denmark)). Oct 1987. 31p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752053/JAW.

Distribution coefficients of technetium and ruthenium are determined under different conditions with CCl/sub 4/, cyclohezanone, and 5 % tri-isooctylamine TIOA/xylene. A method for analyzing /sup 99/Tc in environmental samples has been developed by solvent extraction in which the valences of technetium and ruthenium are controlled with H/sup 2/O/sup 2/ and NaClO. Technetium and ruthenium which are oxidized to TcO/sup -//sub 4/ and RuO/sup -//sub 4/ by NaClO are separated by extraction with CCl/sub 4/ pH=4. The RuO/sup -//sub 4/ is reduced to low valence and technetium is kept i the TcO/sup -//sub 4/ state with H/sub 2/O/sub 2/. Technetium, ruthenium, and other nuclides are subsequently separated by solvent extraction with cyclohexanone and 5% TIOA/xylene. The decontamination of the procedu is 1.35 x 10/sup 5/ for /sup 103/Ru and 1.66 x 10/sup 5/ for /sup 110m/Ag. The chemical yield of technetium-99 is 55%.

22169 **High performance charge transfer device detectors.** Sweedler, J.V.; Bilhorn, R.B.; Epperson, P.M.; Sims, G.R.; Denton, M.B. (Univ. of Arizona, Tucson). *Analytical Chemistry;* **60**: No. 4, 282A-291A(15 Feb 1988).

There is great interest in replacing single-channel photomultiplier tubes (PMTs) with multichannel devices (1,2). Multichannel detectors such as vidicons, intensified target vidicons, image dissectors, and photodiode arrays (PDAs) do not offer the sensitivity, dynamic range, and noise performance necessary to be competitive

with the PMT in many situations. Successful application of these multichannel detectors is limited to experimental conditions in which the multichannel advantage outweighs the noise, cross talk, and dynamic-range disadvantages. New multichannel alternatives to PMT detection are now capable of superior sensitivity and dynamic range when compared on a detector element by detector element basis. In fact, some of these devices exceed the sensitivity and dynamic range of all other available detectors. The performance of charge transfer devices (CTDs) has advanced to the point where the application of this technology to the field of analytical chemistry is appropriate. In the first of this two-part series, the theory, design, operation, and performance of CTD detectors are described. CTDs are solid-state multichannel detectors. These detectors integrate signal information as light strikes them, much like photographic film. The amount of charge generated in a CTD detector is measured either by moving the charge form the detector element where it is collected to a charge-sensing amplifier, or by moving it within the detector element and measuring the voltage change induced by this movement.

22170 **Determination of lead-210 in standard samples of soil, ores, and mill tailings.** Sill, C.W. (EG & G Idaho, Idaho Falls). *Analytical Chemistry;* **60**: No. 4, 320-323(15 Feb 1988). Contract AC07-76ID01570.

Up to 5-G samples were dissolved in hyrofluoric acid and pyrosulfate fusion in the presence of bismuth tracer. The cake was dissolved in hydrochloric acid and bismuth-210 was extracted into diethyldithiocarbamate, separating it from most interferences including its lead-210 parent. Bismuth was then coprecipitated with barium sulfate and counted in a low-background β counter through a 6 mg/cm^2 aluminum absorber to remove α particles from polonium-210. After the sample was counted, the barium sulfate was dissolved in alkaline ehtylenediaminetetraacetic acid, excess potassium iodide was added, and the solution was acidified. The yellow bismuth-iodide complex was measured in a spectrophotometer and the absorbance was compared with that from an identical aliquot of the bismuth solution to determine the chemical yield. Some results obtained in the analysis of soil, uranium ores, and mill tailings that were prepared for use as standards are given. When sufficient activity was present, the relative experimental standard deviations of 10 individual measurements about their own mean was less than 2%. On standards, the results obtained were within 3% of the known values at the 95% confidence level. Chemical yields were generally higher than 98% overall and were determined to better than 0.5%. Detection limits are about 0.1 pCi/g for 5-g samples and 6-h counts.

22171 **Investigation of matrix effects on the neutral fractions ejected from ion-bombarded, uranium-containing solids using resonance ionization mass spectrometry.** Goeringer, D.E.; Christie, W.H.; Valiga, R.E. (Oak Ridge National Lab., TN). *Analytical Chemistry;* **60**: No. 4, 345-349(15 Feb 1988).

Resonance ionization mass spectrometry (RIMS) has been used to investigate the effect of the sample matrix on the yields of U, UO, and UO_2 neutrals desorbed from ion-bombarded, uranium-containing solids. The yield of corresponding secondary ions was also examined by secondary ion mass spectrometry (SIMS). Samples studied were uranium metal, UO_2 (polycrystalline and single crystal), and U_3O_8. The overall efficiency of detection, U^+ photoions counted/U atoms sputtered, was approximately 9 x 10^{-4}. Results indicate that the density of ground-state U atoms sputtered from such samples is quite sensitive to oxygen content and surface contamination. The relative ratio of ground-state U atoms sputtered from U metal and UO_2 (U^0 metal/U^0 oxide) with Ar^+ was estimated as 4.4 X 10^1. This relatively large matrix effect severely limits the applicability of SA/RIMS to quantitative analysis of uranium samples.

22172 **Host-guest complexation. 45. A highly preorganized chromogenic spherand indicator system specific for sodium and lithium ions.** Cram, D.J.; Carmack, R.A.; Helgeson, R.C. (Univ. of California, Los Angeles). *Journal of the American Chemical Society;* **110**: No. 2, 571-577(20 Jan 1988).

The synthesis and chromogenic properties of 1 as a sodium and lithium ion selective indicator system are described. The pK/sub a/ values of 1 in the absence and presence of various metal ions were measured in 80% dioxane-20% water (v/v). Observed values were as follows: Li^+, 5.9; Na^+, 6.9; K^+, 12.7; Ca^{2+}, 12.8; Mg^{2+}, ⍙3.2; 1,5-diazabicyclo[4.3.0]non-5-ene (DBN), 13.0. The noncomplexing model system 21 gave a pK/sub a/ of 10.8 in the same medium. Spherand 1 is yellow (λ/sub max/ 396 nm; epsilon/sub max/ 17,500 L/(mol x cm)), whereas spheraplexes 1^- x Li^+ (λ/sub max/ 586 nm, epsilon/sub max/ 35,500 L/(mol X cm)), and 1^- x Na^+ (λ/sub max/ 596 nm, epsilon/sub max/ 35,500 L/(mol x cm)) as well as uncomplexed 1^- (λ/sub max/ 610 nm, epsilon/sub max/ 53,000 L/(mol x cm)) are deep blue or violet in 80% dioxane-20% water (v/v) and other solvents. Thus 1 is a chromogenic ion-selective indicating system capable of detecting Li^+ and Na^+ at concentrations as low as 10^{-6} M in the presence of other common ions. The binding free energies of spherands 4-6 binding lithium picrate and sodium picrate at 25°C in $CDCl_3$ saturated with D_2O were measured and found to range between 8.4 and 12.5 kcal mol^{-1}, somewhat higher than those for 7, but much lower than those for 2.

22173 **Raman scattering from single solution droplets.** Hang Fung, K.; Tang, I.N. (Brookhaven National Laboratory, Department of Applied Science, Environmental Chemistry Division, Upton, New York 11973). *Applied Optics;* **27**: No. 2, 206-208(15 Jan 1988). Contract AC02-76CH00016.

The Raman spectra of electrodynamically suspended ammonium sulfate and sodium nitrate solution droplets are reported for the first time. (AIP)

22174 **Development of the NBS /sup 10/Be//sup 9/Be isotopic standard reference material.** Inn, K.G.W.; Coursey, B.M.; Raman, S.; Walker, R.L.; Fassett, J.D. (National Bureau of Standards, Gaithersburg, MD, USA. Center for Radiation Research; Oak Ridge National Lab., TN, USA; National Bureau of Standards, Gaithersburg, MD, USA. Center for Analytical Chemistry). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **29**: No. 1/2, 27-31(Nov 1987). (CONF-8704112—).

From 4. international symposium on accelerator mass spectrometry; Ontario, Canada (27 Apr 1987).

The National Bureau of Standards (NBS), in conjunction with the Oak Ridge National Laboratory (ORNL) and the Accelerator Mass Spectrometry (AMS) community, is in the process of developing a /sup 10/Be//sup 9/Be isotopic solution Standard Reference Material (SRM). The starting /sup 10/Be//sup 9/Be solution was provided by the ORNL after Secondary Ionization Mass Spectrometric characterization for isotopic concentration. The radioactivity purity of the ORNL Master solution was confirmed by gamma-ray spectrometry, then diluted at NBS with solutions made from zone-refined single-crystal beryllium metal and sub-boiling double-distilled hydrochloric acid. Four serial dilutions were necessary to achieve a final /sup 10/Be//sup 9/Be isotopic composition of approximately 3 x 10/sup -11/. The accuracy of the dilutions was confirmed by liquid scintillation and AMS measurements. The isotopic composition of the ORNL Master solution was also confirmed at NBS by Resonant Ionization Mass Spectrometry. The isotopic composition of the final solution is being confirmed at the present time through international laboratory AMS measurements.

22175 **/sup 10/Be: Half-life and AMS-standards.** Hofmann, H.J.; Beer, J.; Bonani, G.; Suter, M.; Woelfli, W.; Gunten, H.R. von; Zimmermann, D.; Raman, S.; Walker, R.L. (Eidgenoessische Technische Hochschule, Zurich, Switzerland. Inst. fuer Mittelenergiephysik; Bern Univ., Switzerland. Inst. fuer Radiochemie; Oak Ridge National Lab., TN, USA). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **29**: No. 1/2, 32-36(Nov 1987). (CONF-8704112—).

From 4. international symposium on accelerator mass spectrometry; Ontario, Canada (27 Apr 1987).

Absolute AMS-measurements of /sup 10/Be require reliable standards for calibration. Among the existing standards, rather large differences have been observed. These differences were found partially to be due to the different half-life values which were assumed. Also for comparison of AMS-data with activity measure-

ments, it is necessary to know the /sup 10/Be half-life as precisely as possible. Starting with 5 ml of the standardized ORNL-MASTER solution, a working solution with a well-defined /sup 10/Be content was prepared. Its specific activity was determined by liquid scintillation counting. This measurement yielded a new value of (1.51+-0.06) Ma for the /sup 10/Be half-life, which is in good agreement with the previously reported values but is almost three times more accurate. Two independent dilution series produced new AMS-standards with /sup 10/Be//sup 9/Be-ratios of the order of 10/sup -10/ and 10/sup -11/. These standards were measured at the ETH/SIN-AMS-facility with high accuracy and are compared with other available /sup 10/Be-standards.

22176 **Ion source sample preparation techniques for carbon-14 AMS measurements.** Balsley, D.R.; Farwell, G.W.; Schmidt, F.H.; Grootes, P.M. (Wshington Univ., Seattle, USA. Nuclear Physics Lab.; Washington Univ., Seattle, USA. Quaternary Isotope Lab.; Washington Univ., Seattle, USA. Dept. of Geological Sciences). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **29**: No. 1/2, 37-40(Nov 1987). (CONF-8704112—).

From 4. international symposium on accelerator mass spectrometry; Ontario, Canada (27 Apr 1987).

Our methods for preparing solid graphite and other types of carbon samples possessing good geometrical characteristics and producing large beams are described. Sample material prepared as amorphous carbon, or as graphite powder, is encapsulated in tantalum, compressed to ≃ 14 kbar, and heated in vacuum to ≃ 2500/sup 0/C. The end of the capsule is cut off, exposing a smooth and hard graphite surface which provides excellent emittance in a reflection-type sputter source. The powder is prepared from CO/sub 2/ by the hydrogen-iron powder catalysis method. Silver-carbon mixtures with good geometrical properties can also be prepared with our press.

22177 **Comparison of AES, SIMS, ISS and RBS analysis of Si/sub x/N/sub y/ layers.** Berghe, R. vanden; Vlaeminck, R.; Craen, M. van; Herbots, N.; Gloesener, D.; Wiele, F. van de; Doncker, G. de; Vennik, J.; Tollet, H.; Creemers, C. (Bell Telephone Manufacturing Co., Ghent (Belgium); Oak Ridge National Lab., TN (USA); Louvain Univ., Louvain-la-Neuve (Belgium). Lab. de Microelectronique; Ghent Rijksuniversiteit (Belgium). Lab. voor Kristallografie en Studie van de Vaste Stof). *Fresenius' Zeitschrift fuer Analytische Chemie;* **329**: No. 2/3, 380-384(Nov 1987). (CONF-8606386—).

From 4. working conference on applied surface analysis; Kaiserslautern, F.R. Germany (30 Jun 1986).

Si/sub x/N/sub y/ thin layers were analyzed by AES, SIMS, ISS and RBS. A comparison of the experimental results is made, and the artifacts and characteristics for each experimental method are discussed. It seems that of all these methods, only RBS is suitable for analysing silicon nitride layers.

22178 **Separation of glucuronide, sulfate and glutathione conjugates of benzo(a)pyrene by HPLC.** Merrick, B.A.; Selkirk, J.K. (Biology Div., Oak Ridge National Lab., P.O. Box Y, Oak Ridge, TN 37831). pp 561-578 of Polynuclear aromatic hydrocarbons: Chemistry, characterization and carcinogenesis. Cooke, M.; Dennis, A.J. Columbus, OH; Battelle Press (1986). (CONF-8410225—). Contract AC05-84OR21400.

From 9. international symposium on polynuclear aromatic hydcarbons; Columbus, OH, USA (30 Oct 1984).

The processing kinetics of activation and detoxification of BaP may represent an important determinant in tissue and species susceptibility to chemical carcinogenesis. Description of a complete metabolic profile of BasP entails the development of methods to separate and quantitate aqueous-soluble metabolites. The present study examines the chromatographic properties of sulfate, glucuronide and GSH conjugates on a Dupont C-8 column by HPLC. The analytical conditions were developed with standard BaP conjugates and were utilized to chromatograph aqueous-soluble metabolites from HEF metabolism after removal of organic-soluble metabolites.

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22179 **(BNL—40817) Measuring efficiency factors for the volatilization of $GeCl_4$ and HCl from the $GaCl_3$-HCl solution in the BNL Pilot Facility.** Rowley, J.K.; Stoenner, R.W. (Brookhaven National Lab., Upton, NY (USA)). [1988]. Contract AC02-76CH00016. 18p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006294/JAW.

This report is concerned with the removal of Ge and HCl from an aqueous solution of 7.02M $GaCl_3$-3.3M HCl by bubbling a gas (air) through it and carrying off $GeCl_4$ and HCl. Equilibrium measurements were carried out at the beginning of each run. Three runs were conducted. 5 figs., 3 tabs. (DLC)

22180 **(BNL—40818) Measurement of the volatility of $GeCl_4$ and HCl at 20°C from concentrated aqueous solutions of $GaCl_3$ and HCl.** Rowley, J.K.; Stoenner, R.W. (Brookhaven National Lab., Upton, NY (USA)). [1988]. Contract AC02-76CH00016. 21p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006293/JAW.

The volatilities of $GeCl_4$ and of HCl from concentrated aqueous solutions of $GaCl_3$ and HCl have previously been measured at temperatures varying from 30°C to 60°C. In order to estimate these volatilities at 20°C, the ambient temperature of the tank building at the underground Gran Sasso Laboratory, these results have been extrapolated to this lower temperature. However, the measurements at the other temperatures are two few in number to define adequately the $GaCl_3$ and HCl concentrations with maximum $GeCl_4$ volatility. Also, the extrapolation is uncertain. Because of the importance to the Gallex experiment of defining the region of maximum volatility of $GeCl_4$ so that the optimum solution composition may be used in the solar neutrino experiment, we have performed a systematic study measuring the volatilities of $GeCl_4$ and HCl at 20°C from aqueous solutions of $GaCl_3$ and HCl. Although the conditions of measurement are not identical to those of the full scale experiment, all of the measurements were performed in the same way and the derived values relative to each other should have meaning. For purposes of relating these measurements to the BNL pilot tank measurements, the $GaCl_3$-HCl solution used in the BNL pilot tank was included in the present measurements. 7 figs., 3 tabs.

22181 **(DOE/ER/10829—8) Selectivity, activity and metal-support interactions of Group VIII bimetallic catalysts: Final technical progress report, 15 January 1985-15 July 1987.** Haller, G.L. (Yale Univ., New Haven, CT (USA). Dept. of Chemical Engineering). Nov 1986. Contract AC02-81ER10829. 21p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006517/JAW.

The nature of metal-oxide interaction as exemplified by Rh/TiO_2 and characterized by entended X-ray absorption fine structure (EXAFS) and X-ray absorption near edge structure (XANES) analyses is reviewed. The catalytic consequences of this interaction between a group VIII metal and a reducible support are reviewed by reference to the differences between different group VIII metals (Rh and Pt) supported on TiO_2 and the same metal (Rh) supported on different reducible supports (TiO_2 and V_2O_3). The effect of different silica supports on the metal-metal interaction (Ru-Cu cluster morphology) and on chemisorption and catalytic activity is briefly outlined. Oxide-oxide interaction (MoO_3 and SiO_2 interaction with Al_2O_3 support) investigated by NMR is also addressed. 67 refs., 2 figs.

22182 **(DOE/ER/13296—4) Ligand transformations and catalysis by transition metal cluster compounds containing sulfur: Progress report, 1987.** Adams, R.D. (South Carolina Univ., Columbia (USA). Dept. of Chemistry). Jan 1988. Contract FG09-84ER13296. 15p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006635/JAW.

This progress report covers: tertiary amine metathesis catalysis by metal carbonyl clusters containing carbene ligands; synthesis and transformations of carbene ligands in cluster complexes; and reactivity of mixed metal cluster compounds toward alkynes.

22183 (DOE/ER/13538—2) Synthesis and properties of metallocarboxylic acids: Progress report/continuation proposal, February 1, 1987-January 31, 1988. Gibson, D.H. (Kentucky Univ., Lexington (USA). Dept. of Chemistry). 25 Jan 1988. Contract FG05-86ER13538. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88006064/JAW.

Much of the second year of the grant has been devoted to refinishing the preparative for the anions, $CpFe(CO)(PPh_3)COO^-M^+$ (M=Li, Na, K) and the corresponing calcium salt, and in the establishing the characteristic reactions of these compounds. All of the compounds have been isolated in good yields and characterized spectroscopically by IR(DRIFTS) and by ^1H and ^{13}C NMR. The IR spectral data indicate that each salt is obtained as a hydrate; ^1H NMR data confirm that. To this point we have been unsuccessful in obtaining x-ray quality crystals from any of the salts (we are still trying). Preliminary communications regarding the improved preparation of $CpFe(CO)(PPh_3)COOH$ and its potassim and lithium salts and some of the reactions of the salts have been published (or are in press). Reactions of the metallocarboxylate anions which have been studied to the present time are summarized.

22184 (DOE/ER/13547—T1) Solid-surface luminescence analysis: Progress report, 1 December 1986-31 December 1987. Hurtubise, R.J. (Wyoming Univ., Laramie (USA). Dept. of Chemistry). 1988. Contract FG02-86ER13547. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88006303/JAW.

Modes of interaction of room-temperature solid-surface luminescence were studied for: p-aminobenzoic acid adsorbed on sodium acetate, 4-phenylphenol and bezo (f) quinoline adsorbed on filter paper, organic compounds adsorbed on 80% α-cyclodextrin-sodium choride mixtures, and extended luminescence calibration curves and solvent studies with nitrogen heterocycles. (DLC)

22185 (EPRI-EA—5655) Review of selenium thermodynamic data: Final report. Cowan, C.E. (Battelle Pacific Northwest Lab., Richland, WA (USA)). Feb 1988. Contract AC06-76RL01830. 73p. NTIS, PC A04/MF A01 - RRC, Box 50490, Palo Alto, CA 94303; 1; GPO Dep. Order Number DE88006194/JAW.

This report assesses the accuracy and completeness of available thermodynamic data on selenium. A review of experimental methods from published literature on selenium thermodynamic data focused on chemical reactions responsible for the formation of both aqueous complexes and solid phases of selenate, selenite, and selenide. The reviewer selected best data values, based on the methods used for estimating thermodynamic data. After inclusion of these values into the MINTEQ model, a validation study evaluated model performance for selenite and selenide solid phases. Lack of selenate data precluded model validation for this compound. The review furnished data on 22 aqueous complexes of selenite, 15 of selenide, and 17 of selenate, as well as 21 solid phases of selenite, 20 of selenide and 8 of selenate. These data proved inadequate to represent the formation of species in the solid phase. The validation study gave inconclusive predictions of selenite and selenide solubility and could not be used to assess the accuracy or completeness of the thermodynamic data. 11 figs., 25 tabs.

22186 (INIS-mf—10846, pp 73) Fluorescent study of Rhodamon-B binding to types of artificial membranes. Antonov, P.; Pancheva, R.; Naplatarova, M. (Meditsinska Akademiya, Sofia, Bulgaria). Nov 1984. (In Bulgarian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

22187 (LBL—24050) The effects of metal promotion on the adsorptive and catalytic properties of rhodium. Levin, M.E. (Lawrence Berkeley Lab., CA (USA)). Dec 1987. Contract AC03-76SF00098. 223p. NTIS, PC A10/MF A01; 1; GPO Dep. Order Number DE88006339/JAW.

The properties of Rh with alumina and titania overlayers have been studied to understand the influence of the support oxides in the analogous alumina- and titania-supported catalysts. Al and Ti were deposited on a Rh foil in ultrahigh vacuum and subsequently oxidized. Characterization of the deposits with Auger electron spectroscopy (AES) and x-ray photoelectron spectroscopy (XPS) showed the oxides to be nearly stoichiometric with overlayer growth occurring through the Stranski-Krastanov mechanism (i.e., two-dimensional growth until completion of the monolayer). AES and XPS also showed the titania to be more easily reduced by H_2 or CO at elevated temperatures than was the alumina. Alumina overlayers were found to diminish both CO chemisorption and hydrogenation in direct proportion to the coverage. Titania caused a much sharper suppression in the CO chemisorption while enhancing the CO hydrogenation rate at low coverages. The higher rates were accompanied by dramatic changes in the kinetic parameter and hydrocarbon selectivity. Ethylene hydrogenation and ethane hydrogenolysis, though, were sharply suppressed by the presence of titania. Titania is believed to exist as two-dimensional islands on the Rh surface at submonolayer coverages. XPS results indicate that Ti^{3+} species appear to populate the perimeter of these oxide islands. These Ti^{3+} species at the oxide perimeter may influence the properties of and the chemical processes taking place at Rh atoms at the oxide/metal interface. The suppression of CO chemisorption when titania is present has been described by a model in which CO does not chemisorb at Rh sites underneath as well as alongside these islands, while an ensemble of Rh and Ti atoms at the oxide/metal interface (along the island perimeter) has been used to model the enhancement in CO hydrogenation rate. 156 refs., 82 figs., 5 tabs.

22188 (LBL—24469) Methods of obtaining thermodynamic data. Brewer, L. (California Univ., Berkeley (USA). Dept. of Chemistry; Lawrence Berkeley Lab., CA (USA)). Oct 1987. Contract AC03-76SF00098. 16p. (CONF-871236—4). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006351/JAW.

From Workshop on chemical processes and producers in severe reactor accidents; Captiva Island, FL, USA (9 Dec 1987).

The types of thermodynamic data needed to predict behavior of high temperature systems such as an overheated nuclear reactor in which the fuel has been exposed to water and oxygen are discussed. Procedures for obtaining the needed data are reviewed. 14 refs.

22189 (LBL—24627) Prediction of high-temperature thermodynamic properties of mixed electrolyte solutions including solubility equilibria, vapor pressure depression and boiling point elevation. Pabalan, R.T.; Pitzer, K.S. (Lawrence Berkeley Lab., CA (USA)). Jan 1988. Contract AC03-76SF00098. 18p. (CONF-8708178—2). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006344/JAW.

From Temperature aqueous solutions; Provo, UT, USA (25 Aug 1987).

The Pitzer ion-interaction model, which is theoretically derived but uses empirical parameters evaluated from experimental data on binary and ternary aqueous mixtures, is shown to accurately predict thermodynamic properties of aqueous eletrolytes to high temperatures and concentrations and for more complex compositions. Applications of the model include calculations of solubility equilibria, vapor pressures and boiling points of electrolyte mixtures. Examples of these calculations are given below. 32 refs., 5 figs., 2 tabs.

22190 (LBL—24635) Crossed molecular beam studies of substitution and exchange reactions. Robinson, G.N. (California Univ., Berkeley (USA). Dept. of Chemistry; Lawrence Berkeley Lab., CA (USA)). Dec 1987. Contract AC03-76SF00098. 206p. NTIS, PC A10/MF A01; 1; GPO Dep. Order Number DE88006322/JAW.

Atom + alkene/aromatic and radical + iodoalkane reactions have been studied. $F + C_2H_4 \rightarrow [C_2H_4F]^* \rightarrow H + C_2H_3F$ was studied at low collision energies. The substitution cross section decreases with increasing E/sub c/, suggesting that long-range attractive forces dominate the $F\text{-}C_2H_4$ interaction. The CM frame C_2H_3F angular distributions may reflect unusual angular momentum partitioning in the C_2H_4F collision complex. Chapters 2 and 3 describe studies of endoergic substitution reactions, Br + R-Cl → R-

Br + Cl, where R-Cl = 0-, m-, and p-$CH_3C_6H_4Cl$, C_6X_5Cl (X = H, F), and 1,1- and trans-$C_2H_2Cl_2$ in the collision energy range 15 to 35 kcal/mol. Br adds to the double bond to form a weakly bound collision complex which then decomposes through Cl elimination. Competition between intramolecuar vibrational modes and Cl elimination results in translational energy distributions and excitation functions that can be modeled by a limited number of vibrational modes participating in energy sharing prior to bond fission. Substituents influence the orientation and probability of Br addition as well as energy redistribution. The first crossed beam studies of CH_3 radicals with polyatomic molecules are reported in Chapter 4. The CH_3I products from the reactions CH_3 + R-I → CH_3I + R (R = CF_3, $(CH_3)_3C$) are strongly backward scattered, indicating a preferred collinear CH_3-I-R configuration. Most of the 15 kcal/mol of available energy is channeled into product translation (50% for R = $(CH_3)_3C$ and 70% for R = CF_3). This large repulsive energy release is rationalized in terms of stability of the CH_3-I-R transition structures. 199 refs., 47 figs., 8 tabs.

22191 **(N—88-13385) Phase purity of $NiCo_2O_4$, a catalyst candidate for electrolysis of water.** Singer, J.; Fielder, W.L.; Garlick, R.G.; Negas, T. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Dec 1987. 11p. (NASA-TM—100239; E—3754; NAS—1.15:100239). NTIS, PC A03/MF A01.

$NiCo_2O_4$ is shown to be difficult to obtain as a pure phase, and may never have been so obtained. High resolution x-ray diffractometry is required for its precise characterization. Film XRD is not likely to show the asymmetry in the spinel diffraction lines, caused by poorly crystallized NiO, as seen in diffractometer traces. The Co_3O_4 which is expected to accompany NiO as an impurity in $NiCo_2O_4$ syntheses has the same diffraction pattern as the binary oxide. Firings of the co-precipitated hydroxides at 300, 350, and 400 C, including one in pure O_2, failed to produce single phase cobaltate. Scanning electron microscopy showed all the sintered products to range over several orders of magnitude in agglomerate/particle size. Surface areas by BET were all in the range 40 to 110 m sq/g, equivalent to particles of 200 to 100 Angstrom diameter. The spinel diffraction line breadths were compatible with those approximate dimensions.

22192 **Effect of antiphase boundaries on the kinetics of short-range ordering by a vacancy mechanism.** Fultz, B. (Division of Engineering and Applied Science, California Institute of Technology, Pasadena, California 91125). *Journal of Chemical Physics;* **88**: No. 5, 3227-3229(1 Mar 1988).

In Monte Carlo simulations of chemical short-range ordering on a square lattice, the number of single-atom domains was found to depend on the presence of antiphase boundaries and on the mechanism by which ordering occurred. When antiphase boundaries were present and the ordering occurred by a vacancy mechanism, the number of single-atom domains was found to increase with decreasing temperature, in contrast to thermodynamic predictions. This is understood as a consequence of highly correlated vacancy motions in those regions of the lattice away from antiphase boundaries.

22193 **Surface potential of the water liquid—vapor interface.** Wilson, M.A.; Pohorille, A.; Pratt, L.R. (Department of Chemistry, University of California, Berkeley, California 94720). *Journal of Chemical Physics;* **88**: No. 5, 3281-3285(1 Mar 1988).

The surface potential of the water liquid—vapor interface is studied by molecular dynamics using the TIP4P model. The surface potential predicted by this empirical model is -(130 +- 50)mV. This value for the surface potential is of reasonable magnitude but of opposite sign to the expectations derived from laboratory experiments. The electrostatic potential displays a nonmonotonic variation with depth into the liquid. This nonmonotonic variation is explained on the basis of the nondipolar charge distribution of the H_2O molecule and the observation that the more probable molecular orientations in the interfacial region place the molecular symmetry axis near the plane of the interface. It is shown that minor changes in the assumed molecular charge distribution can bring the computed surface potential into agreement with experimental expectations without qualitatively altering the nonmonotonic variation of the electrostatic potential through the interfacial region. Computed quantum mechanical descriptions of the electron distribution of the isolated H_2O molecule are not compatible with the surface structure predicted by the TIP4P model and the experimental expectation that the surface potential of the water liquid—vapor interface is small, roughly of the order of 10—100 mV. The surface potential is sensitive to details in the large distance wings of the molecular electron distribution. It is hypothesized that the surface environment qualitatively alters the wings of the distribution from the result obtained by a superposition of the isolated molecule electron densities.

22194 **Semiconductor particles in bilayer lipid membranes. Formation, characterization, and photoelectrochemistry.** Zhao, X.K.; Baral, S.B.; Rolandi, R.; Fendler, J.H. (Syracuse Univ., NY). *Journal of the American Chemical Society;* **110**: No. 4, 1012-1024(17 Feb 1988).

Bilayer lipid membranes (BLMs) have been formed from bovine brain phosphatidylserine (PS), glyceryl monooleate (GMO), and a ploymerizable surfactant, $[n\text{-}C_{15}H_{31}CO_2(CH_2)]_2N^+(CH_3)CH_2C_6H_4CH{=}{=}CH_2Cl^-$ (STYRS). These BLMs were then used to provide matrices for the in situ generation of microcrystalline CdS, CuS, Cu_2S, PbS, ZnS, HgS, and In_2S_3. Semiconductors were formed by injecting appropriate metal ion precursors and H_2S into the bathing solutions on opposite sides of the BLM. Their presence was established by voltage-dependent capacitance measurements, absorption spectroscopy, and optical microscopy. Subsequent to the injection of H_2S, the first observable change was the appearance of fairly uniform white dots on the black film. These dots rapidly moved around and grew in size, forming islands that then merged with themselves and with a second generation of dots, which ultimately led to a continuous film that continued to grow in thickness. Film formation and growth were monitored by simultaneous optical thickness and capacitance measurements. These data were treated in terms of an equivalent R-C circuit and allowed for the assessment of the semiconductor penetration depth into the BLM. This value for a GMO-BLM-supported In_2S_3 film was determined to be 24 A. Bandgap excitation, by nanosecond-pulsed or continuous illumination of the BLM-supported semiconductor film, led to observable photoelectric effects. Visible light ($\lambda > 350$ nm) excitation into STYRS-BLM-supported CdS led to polymerization of the styrene moiety of STYRS. BLM-supported semiconductors remained stable for days.

22195 **Electronic absorptions in the high T/sub c/ superconductor YBa_2Cu_3O/sub x/.** Little, W.A.; Collman, J.P.; Yee, G.T.; Holcomb, M.J.; McDevitt, J.T.; Brown, G.E. (Stanford Univ., CA). *Journal of the American Chemical Society;* **110**: No. 4, 1301-1302(17 Feb 1988). Contract FG03-86ER45245.

Here the authors report spectroscopic studies of high-purity samples of YBa_2Cu_3O/sub x/ as well as several impurity phases identified as possible contaminants. This low-lying electronic transition is characteristic of YBa_2Cu_3O/sub x/, is not due to an impurity phase, and does correlate with T/sub c/. It is possibly connected to an exciton interaction.

22196 **X-ray absorption study of octafluorodirhenate(III): EXAFS structures and resonance raman spectroscopy of octahalodirhenates.** Conradson, S.D.; Sattelberger, A.P.; Woodruff, W.H. (Los Alamos National Lab., NM). *Journal of the American Chemical Society;* **110**: No. 4, 1309-1311(17 Feb 1988).

The structure, bonding, spectroscopy, and photophysics of transition-metal complexes containing quadruple metal-metal bonds are subjects of intense and general interest. For both historic and fundamental reasons, the octahalodirhenate(III) ions have become the paradigms of this field. Extensive spectroscopic and photophysical studies exist for the entire $Re_2X_8^{2-}$ series (X = F, Cl, Br, and I). However, while excellent structural data exist for X = Cl and Br, the structures of $Re_2Fe_8^{2-}$ and $Re_2I_8^{2-}$ have not been determined. These structures are essential for complete understanding of the bonding and physical and chemical behavior in these systems. Toward this end, the authors report structural features of $Re_2F_8^{2-}$ determined by extended X-ray absorption fine structure (EXAFS) spectroscopy. They also report X-ray absorption near-edge spectra

(XANES); resonance Raman (RR) spectra have been determined previously by others and subsequently by the authors. They find that in $Re_2F_9^{2-}$ the Re-Re distance is 2.20 Angstrom and the Re-F distance is 1.95 A. Both of these distances are unexpected considering the corresponding stretching frequencies in the RR spectra.

22197 **High-resolution ESR spectroscopy and structure of the acetaldehyde radical cation (CH_3CHO^+) in neon matrices at 4 K: comparison with results in freon matrices.** Knight, L.B. Jr.; Gregory, B.W.; Cobranchi, S.T.; Williams, F.; Qin, X.Z. (Furman Univ., Greenville, SC). *Journal of the American Chemical Society;* **110**: No. 2, 327-336(20 Jan 1988).

Detailed ESR studies are reported for the acetaldehyde radical cation (CH_3CHO^+) trapped in neon matrices. The cation was generated by photoionization, electron bombardment, or laser multiphoton ionization of dilute acetaldehyde neon mixtures (10^2 to 10^4 dilution factor) during codeposition on a flat target at 4 K. Its ESR spectrum was well resolved and showed strong preferential orientation effects, two sets of strong features being observed for field directions in the target plane, while another set of weaker line components became strongly enhanced when the field was applied normal to this plane. These results indicate that the cations are aligned with their CCHO planes parallel to the deposition surface. Accordingly, the largest principal value of the g tensor is found to perpendicular to the CCHO plane, as previously determined for the formaldehyde cation (H_2CO^+). The measured values of the g and aldehydic ^1H hyperfine tensors are consistent with the assignment of the unpaired electron to the nonbonding oxygen-centered 10a' molecular orbital which is, however, about 50% delocalized onto the aldehydic hydrogen (1s) and methyl carbon (2p) orbitals. The g and aldehydic ^1H A tensor components are the following: g/sub x/ = 2.0069 (3), A/sub x/ = 355 (1) MHz; g/sub z/ = 2.0019 (6), A/sub z/ = 374 (3) MHz, g/sub y/ = 2.0026 (3), A/sub y/ = 353 (1) MHz. The much smaller hyperfine interaction (4.3 MHz) with the hydrogens of the methyl group is exceedingly well resolved into a 1:1:1:1 quartet at 4 K with the field normal to the CCHO plane. In contrast to the neon studies, the ESR spectra of the acetaldehyde radical cation in Freon matrices show much poorer resolution and are complicated by the appearance of a highly structures anisotropic ^{35}Cl hyperfine interaction below 120 K.

22198 **Gas-phase reactions of $LaFe^+$ with alkanes.** Huang, Y.; Freiser, B.S. (Purdue Univ., West Lafayette, IN). *Journal of the American Chemical Society;* **110**: No. 2, 387-392(20 Jan 1988). Contract AC02-80ER10689.

The formation and reactions of $LaFe^+$ with saturated hydrocarbons are reported. Laser-generated La^+ reacts with iron pentacarbonyl to yield predominantly $LaFe(CO)_3^+$, which upon collisional activation yields $LaFe^+$. The reactions of $LaFe^+$ with alkanes are quite different from that of either La^+ or Fe^+. Dehydrogenation is common for the reactions of $LaFe^+$ with alkanes. Dehydrogenation and methane elimination are observed for the reaction of neopentane with $LaFe^+$. Carbon-carbon cleavage and dehydrogenation occur in the reactions of $LaFe^+$ with C_5 and C_4 cyclic alkanes, while dehydrogenation is observed exclusively for cyclopentane, cyclohexane, and methylcyclohexane. The reactivity of $LaFe^+$ is particularly interesting in that several other heterodinuclear ions have been observed to be unreactive with alkanes, although their constituent monoatomic ions are reactive. $D^0(La^+Fe)$ was determined to be 48 +/- 5 kcal/mol by photodissociation.

22199 **Electron-transfer kinetics of Zn substituted cytochrome c and its $Ru(NH_3)_5$(Histidine-33) derivative.** Elias, H.; Chou, M.H.; Winkler, J.R. (Brookhaven National Lab., Upton, NY). *Journal of the American Chemical Society;* **110**: No. 2, 429-434(20 Jan 1988). Contract AC02-76CH00016.

The kinetics of the bimolecular electron transfers from triplet-excited zinc-substituted horse heart cytochrome c (Zn-cyt c*) to $Ru(NH_3)_5L^{3+}$ have been measured (L = NH_3, k(298 K) = 1.4 x 10^7 M^{-1} s^{-1}; L = histidine, k(298 K) = 2.4 x 10^7 M^{-1} s^{-1}), along with those of the corresponding thermal back-reactions (L = NH_3, k(298 K) = 1.5 x 10^8 M^{-1} s^{-1}; L = histidine, k(298 K) = 3.6 x 10^8 M^{-1} s^{-1}). The derivatized metalloprotein ruthenium pentaammine histidine-33-zinc-substituted cytochrome c (Ru-Zn-cyt c) has been prepared and characterized by atomic absorption spectroscopy and HPLC analysis of its tryptic digestion fragments. The rate of intraprotein electron transfer from the triplet-excited Zn-porphyrin moiety to the 11.8-A distant $Ru(NH_3)_5$(His-33)$^{3+}$ residue (k(298 K) = 7.7 x 10^5 s^{-1}), as well as that of the thermal back-reaction (k(298 K) = 1.6 x 10^6 s^{-1}), has been measured by transient spectroscopy. Intraprotein electron transfer from Ru(II) quenches Zn-cyt c* with a rate constant of 2.4 x 10^2 s^{-1}. These kinetics are discussed in terms of the semiclassical theory of electron-transfer reactions.

22200 **Reactivity of trimetallic organoyttrium hydride complexes. Synthesis of the alkoxy hydride anions [[(C_5H_5)$_2$Y(μ-H)]/sub x/[(C_5H_5)$_2$Y(μ=-OCH$_3$)]/sub 3-x/(μ_3-H)$^-$ (X = 0-2) including the X-ray crystal structure of [[(C_5H_5)$_2$Y(μ-OCH$_3$)]$_3$(μ_3-H)]$_2$[Li(THF)$_3$]$_2$/sup 1,2/.** Evans, W.J.; Sollberger, M.S.; Khan, S.I.; Bau, R. (Univ. of California, Irvine). *Journal of the American Chemical Society;* **110**: No. 2, 439-446(20 Jan 1988).

[[(C_5H_5)$_2$Y(μ-H)]$_3$(μ_3-H)][Li(THF)$_4$] (1) reacts with 1 equiv of CH_3OH at 0°C to form [[(C_5H_5)$_2$Y(μ-OCH$_3$)][(C_5H_5)$_2$Y(μ-H)]$_2$(μ_3-H)][Li(THF)$_4$] (2) Reaction of 1 with 2 equiv of CH_3OH or 2 with 1 equiv of CH_3OH at 0°C forms [[(C_5)$_2$Y(μ-OCH$_3$)]$_2$[(C H_5)$_2$y(μ-H)](μ_3-H)][Li(THF)$_4$] (3) [[(C_5H_5)$_2$Y(μ-OCH$_3$)]$_3$(μ_3-H)][Li(THF)$_4$] (4) can be formed from 1-3 with the appropriate amount of CH_3OH at 0°C. The central μ_3-H of these trimers does not react with CH_3OH. All trimetallic species were identified by elemental analysis, hydrolytic decomposition and ^1H NMR spectroscopy. Crystallization of 4 from THF gives [[(C_5H_5)$_2$Y(μ-OCH$_3$)]$_3$(μ-H)]$_2$[Li(THF)$_3$]$_2$ (5) in space group $P2_1/n$ with the following unit cell dimensions: a = 20.852 (9), b = 13.984 (5), c = 31.590 (9) A, β = 92.48 (4)°, V = 9203 (7) A^3, Z = 8; D/sub calcd/ = 1.81 g cm^{-3}.

22201 **Distance dependence of intramolecular electron-transfer rates: importance of the nuclear factor.** Isied, S.S.; Vassilian, A.; Wishart, J.F.; Creutz, C.; Schwarz, H.A.; Sutin, N. (State Univ. of New Jersey, New Brunswick). *Journal of the American Chemical Society;* **110**: No. 2, 635-637(20 Jan 1988). Contract AC02-76CH00016.

The conventional assumption that the distance dependence of the rate constant depends only on the electronic factor is questioned. It is shown for polyproline systems that the nuclear factor is larger than the electronic factor. It is shown further, that relative importance of nuclear and electronic factors must be considered when determining the distance dependence of electron transfer rates.

22202 **Use of $Ir_4(CO)_{11}$ to measure the lengths of organic molecules with a scanning transmission electron microscope.** Furuya, F.R.; Miller, L.L.; Hainfield, J.F.; Christopfel, W.C.; Kenny, P.W. (Univ. of Minnesota, Minneapolis). *Journal of the American Chemical Society;* **110**: No. 2, 641-643(20 Jan 1988).

The authors report an evaluation of the hypothesis that metal-cluster labels can be used to accurately measure molecular distances by transmission electron microscopy (TEM). Organic and most small biological molecules are essentially transparent in TEM, but distances between molecular sites can in principle be measured by attachment of electron-dense clusters to those sites. The present test utilized a sufficiently long and rigid organic spacer with specifically attached $Ir_4(CO)_{11}$ labels and took advantage of the capabilities of scanning transmission electron microscopy (STEM) for high resolution measurements on molecular materials. Ir_4-$(CO)_{11}$-labeled molecules, which have not previously been used for TEM, are shown to be synthetically accessible, sufficiently stable, and immobile in the electron beam so that they may have wider TEM applicability.

22203 **A generalized bubble diameter correlation for gas-solid fluidized beds.** Horio, M.; Nonaka, A. (Dept. of Applied Chemistry for Resources, Tokyo Univ. of Agriculture and Technology, Koganei, Tokyo 184). *A.I.Ch.E. Journal (New York);* **33**: No. 11, 1865-1872(Nov 1987).

A new bubble diameter correlation is derived to predict bubbling characteristics of fluidized beds of varieties of powders. The present model is founded on the postulate that the steady bubble size, which is often called the maximum stable diameter, observed

in a bed of Geldart group A powder is formed as a result of an equilibrium of successive coalescence and splitting. For the cases of group B powders the present correlation automatically converges to the conventional correlation. For group A powders the present correlation is validated by comparison with experimental data in the literature. Based on this correlation a theoretical explanation is presented for the fact that the maximum bubble diameters observed were up to 50 to 100 times as large as those from the stable bubble theory.

22204 **A numerical study of global bifurcations in chemical dynamics.** Kevrekidis, I.G. (Center for Nonlinear Studies and Theoretical Div., Los Alamos National Lab., Los Alamos, NM 87545). *A.I.Ch.E. Journal (New York);* **33**: No. 11, 1850-1864(Nov 1987).

Global bifurcations are frequently encountered in the dynamic behavior of chemically reacting systems and their models. They cause dramatic qualitative changes in the system response, such as the birth and death of oscillations and even the onset of chaos. They involve entire regions of the system phase space, and due to their nature they are in general not predictable by standard local bifurcation methods, analytical or numerical. Special methods and algorithms must therefore be developed to locate and analyze them in parameter space. This paper presents such methods and algorithms and illustrates them through standard chemical engineering examples. Test cases include lumped chemical reactor models (homogeneous and heterogeneous, autonomous and periodically forced), a problem of compressible gas flow in porous media, and a case of two coupled oscillators. The phenomena discussed include infinite-period bifurcations, saddle connections, frequency locking, and the creation and extinction of multifrequency responses through global manifold interactions (homoclinic tangles).

22205 **Synthesis, structure, and reactivity of transition-metal/main-group-metal bridging carboxylate complexes of the formula (eta^5-C_5H_5)Re(NO)(PPh_3)(CO_2ML/sub n/)(M = Li, K, Ge, Sn, Pb).** Senn, D.R.; Gladysz, J.A.; Emerson, K.E.; Larsen, R.D. (Univ. of Utah, Salt Lake City). *Inorganic Chemistry;* **26**: No. 17, 2737-2739(26 Aug 1987).

The synthesis of the rhenium/main-group-metal bridging CO_2 or carboxylate complexes of the formula (eta^5-C_5H_5)Re(NO)(PPh_3)(CO_2ML/sub n/) where M = Li, K, Ge, Sn, or Pb from the rhenium carboxylic acid (eta^5-C_5H_5)Re(NO)(PPh_3)(COOH) is reported. The molecular structure of the complexes was investigated, and both monodentate and bidentate carboxylate binding modes were observed with the symmetrical bidentate binding in the tin complex being unprecedented. Clean thermal decarboxylation occurs when the main-group metal is tin or lead to provide a convenient route to the preparation of heterobimetallic complexes. 14 references, 1 figure.

22206 **Electrochemical and resonance Raman spectroscopic characterization of polyaniline and polyaniline-metalloporphyrin electrode films.** Macor, K.A.; Su, Y.O.; Miller, L.A.; Spiro, T.G. (Princeton Univ., NJ). *Inorganic Chemistry;* **26**: No. 16, 2594-2598(12 Aug 1987). Contract AC02-81ER10861.

Characteristics of electropolymerized aniline and metallotetrakis(2-aminophenyl)porphine (metallo-2-TAPP) films are described. Aniline polymerized from methylene chloride solution by oxidative cycling at a platinum electrode shows characteristic two-wave or one-wave cycle voltammograms when scanned in pH 1 aqueous solution, depending on the positive potential sweep limit. Similar CV's are produced when the solution contains metallo-TAPP's, except that additional waves associated with metalloporphyrin redox processes are superimposed. The absorption spectra of the films formed on transparent SnO_2 electrodes showed characteristic metalloporphyrin Soret absorption bands, with red shifts relative to the solution spectra, due to axial coordination and/or excitonic effects. Raman spectra are reported for films polymerized from aniline, aniline-^{15}N, aniline-N,N-d_2, and aniline-d_5. The replacement of strong aniline bands at 1000 and 1029 cm^{-1} with bands in the films at 1190 and 1200 cm^{-1} is diagnostic for para-substituted aniline units in the polymer. The films show a strong ^{15}N-sensitive band at 1525 cm^{-1}, which is absent in aniline but present in p-phenylenediamine. Thus the electrochemical and spectroscopic characteristics of the TAPP films are fully consistent with unmodified porphyrin units contained within a polyaniline polymer. Porphyrin radical cation formation is insufficient to induce polymerization if the potential is lower than that required for aniline oxidation. Films containing Mn(2-TAPP) show a Mn/sup 3+/2+/ wave at ~-0.2 V, negative of the polyaniline redox waves, when the electrode is in contact with nonaqueous or aqueous electrolyte. The metalloporphyrin redox process does not require electronic conduction through the polyaniline framework. 21 references. 8 figures.

22207 **Thermodynamics of highly dilute solutions and the quest for ultrapurity.** Sciamanna, S.F.; Prausnitz, J.M. (Materials and Molecular Research Div., Lawrence Berkeley Lab. and Chemical Engineering Dept., Univ. of California, Berkeley, CA 94720). *A.I.Ch.E. Journal (New York);* **33**: No. 8, 1315-1321(Aug 1987).

Since very high purity is sometimes required for health-related (and other) products, it is useful to reexamine the common thermodynamic relations that describe the chemical potential of a solute at very high dilution. Because Stirling's approximation is not valid for small numbers, the usual thermodynamic relations must be reformulated for small systems, i.e. for a solute in a small bubble or drop. A simplistic analysis indicates that in a small bubble or drop, the chemical potential of a solute goes to a finite value as the mole fraction of solute goes to zero, in contrast to the conventional result, where that chemical potential goes to negative infinity. This simplistic analysis has profound implications for separation science; it implies that (in theory) ultrapurity may be attained by conventional diffusional methods. While serious objections can be raised to invalidate the simplistic analysis, it may nevertheless be useful for chemical engineers to consider separation methods using highly dispersed systems.

22208 **Isotopic exchange of beryllium hydride with deuterium.** Lakner, J.F. (Lawrence Livermore National Lab., Univ. of California, Livermore, CA). *A.I.Ch.E. Journal (New York);* **33**: No. 5, 876(May 1987).

Beryllium hydride has been synthesized by Ethyl Corporation workers based upon a modification of the method of Coates and Holley, a method that gives product purities of 90-98 wt.%. The direct synthesis using beryllium powder and hydrogen has been unsuccessful. Beryllium deuteride can also be prepared by Ethyl Corporation's process using all-deuterated organic reactants. However, it is difficult to replace all deuterium atoms in hydrogenated alkyls, and the procedures are slow and costly. This note reports a process of producing beryllium deuteride by activating pyrolysis-process beryllium hydride and exchanging the hydride with deuterium gas under pressure and temperature.

4004 Electrochemistry

REFER ALSO TO CITATION(S) 21139, 21978, 22189, 22194

22209 **(MINTEK-M—290) The electrodeposition of lead from chloride electrolytes.** Wright, A. (Council for Mineral Technology, Randburg (South Africa). Mineral and Process Chemistry Div.). 28 Nov 1986. 29p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88900328/JAW.

At low current densities, lead was deposited onto a lead substrate as a fine powder that did not adhere well to the substrate. At higher current densities dendritic growth occurred. Lead does not adhere to a graphite substrate and, since copper and titanium substrates require higher cell voltages than lead substrates, these three substrates were rejected. The temperature of the electrolyte must be maintained above 69°C to avoid the precipitation of lead chloride in the cell. Optimum current efficiencies at the anode and cathode were obtained at 80°C, and no improvement in the morphology of the deposit was observed at higher temperatures. A combination of Quebracho extract and cuprous ions achieved the greatest improvement in the morphology of the deposit, while maintaining high current efficiencies at the anode and cathode. However, when the deposition time was increased, dendritic growth was much in evidence. A compact, adherent deposit of lead could not be obtained from chloride electrolytes. 22 refs., 21 figs., 11 tabs.

22210 **Electrochemistry of iodide in propylene carbonate.** Hanson, K.J.; Tobias, C.W. (AT and T Bell Labs., Murray Hill, NJ). *Journal of the Electrochemical Society;* **134**: No. 9, 2204-2210(Sep 1987).

The electrochemistry of iodide in propylene carbonate (PC) was investigated using cyclic voltammetry. In an anodic sweep, iodide is oxidized sequentially to triiodide and then to iodine according to 3I/sup -/ → I/sub 3//sup -/ + 2e/sup -/ [I] 2I/sub 3// sup -/ → 3I/sub 2/ + 2e/sup -/ [II]. This mechanism was confirmed using UV-visible spectroscopy in conjunction with cyclic voltammetry experiments at a thin gold mesh electrode. Potential step experiments were used to measure a diffusion coefficient of 4 X 10/sup -6/ cm/sup 2//s for iodide in a KAsF/sub 6/ PC electrolyte.

22211 **The periodic, electrochemical codeposition of cadmium and tellurium.** Verbrugge, M.W.; Tobias, C.W. (Dept. of Chemical Engineering, Univ. of California at Berkeley, and Materials and Molecular Research Div., Lawrence Berkeley Lab., Berkeley, CA 94720). *A.I.Ch.E. Journal (New York);* **33**: No. 4, 628-642(Apr 1987). Contract AC03-76SF00098.

A mathematical model is presented for the codeposition of cadmium and tellurium onto a rotating-disk electrode. The treatment incorporates the equation of convective diffusion for liquid phase mass transport, Butler-Volmer expressions for charge-transfer reactions, and a thermodynamic model for individual component activities in the solid state. Because of the formation of CdTe, a compound that has a large negative free energy of formation, the cadmium deposition reaction occurs at potentials substantially positive to its standard electrode potential (U/sup Θ/ = -0.40V). This reaction, along with the deposition of tellurium (U/sup Θ/ = +0.55V), produces an electrodeposit that contains cadmium, tellurium, and cadmium telluride. The model can be used to calculate transient current-potential relationships, ionic concentration profiles, and deposit compositions. Transport and kinetic parameters for cadmium and tellurium deposition are reported; a multidimensional optimization routine is used to evaluate physiochemical parameters from experimental data for the codeposition process.

4005 Photochemistry

REFER ALSO TO CITATION(S) 21264, 22194, 22199, 22214, 22353

22212 **Photoinduced intramolecular electron transfer in peptide-bridged molecules.** Schanze, K.S.; Sauer, K. (Lawrence Berkeley Lab., CA). *Journal of the American Chemical Society;* **110**: No. 4, 1180-1186(17 Feb 1988). Contract AC03-76SF00098.

Two series of molecules have been prepared and characterized in which a polypyridyl Ru(II) complex is linked to p-dimethoxybenzene (DMB) and p-benzoquinone (Q) moieties by peptide bridges containing the amino acid L-proline (Pro). The photophysical properties of the metal-to-ligand charge transfer (MLCT) excited state of the Ru(II) chromophore have been examined for the complexes with 0, 1, 2, 3, and 4 intervening Pro residues. Steady state and time resolved luminescence experiments on the Pro-bridged DMB system show that the properties of the Ru MLCT excited state are only slightly modified from those of an unsubstituted model complex by the presence of covalently attached DMB peptides. Experiments on the Pro-bridged Ru-Q complexes show that the Q site quenches the yield and lifetime of the Ru MLCT emission. Furthermore, the quenching efficiency is diminished as the number of peptide spacers is increased. The quenching process is ascribed to long-range intramolecular Ru-to-Q electron transfer. This hypothesis is supported by time-resolved luminescence data which suggest that the average electron transfer rate falls sharply with an increase in the peptide bridge length.

4006 Radiation Chemistry

REFER ALSO TO CITATION(S) 22100, 22120, 23017, 23745, 23754, 23755

22213 **(CONF-8612121—) Radiochemistry and radiation chemistry symposium: Preprints volume.** (Department of Atomic Energy, Bombay (India). Board of Research in Nuclear Sciences). 1986. 568p. NTIS (US Sales Only), PC A24. Order Number DE88900330/JAW.

From 7. DAE symposium on radiochemistry and radiation chemistry; Tirupati, India (13 Dec 1986).

This year's DAE symposium on Radiochemistry and Radiation Chemistry was held at Sri Venkateswara University, Tirupati, December 13-17, 1986. This volume contains abstracts of contributed papers and invited talks.

22214 **(DOE/ER/13404—3) The contribution of electronically excited states to the radiation chemistry of organic systems: Progress report, June 30, 1985-December 30, 1987.** Lipsky, S. (Minnesota Univ., Minneapolis (USA). Dept. of Chemistry). 1987. Contract FG02-85ER13404. 24p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88006290/JAW.

Research progress is reported on the following topics: effects of electron scavengers on the escape probabilities of geminate ion pairs, mechanism of liquid scintillation counter, photoionization of solutes in nonpolar liquids, kinetics of recombination of geminate ion pairs, and fluorescence of saturated hydrocarbons. (DLC)

22215 (INIS-mf—10846, pp 34) **Effect of radiation atomic vacancies accumulation in disordered areas of organic crystals, polymers and quasiperiodic biostructures by their radiation destruction.** Komar', I.N.; Georgiev, B.P. (Khar'kovskij Gosudarstvennyj Univ., Ukrainian SSR). Nov 1984. (In Bulgarian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

22216 (INIS-mf—10846, pp 34) **New mechanism of some radiation stimulated effects in dielectric media of arbitrary complexity arranged biostructures.** Komar', I.; Segnoutka, T. (Khar'kovskij Gosudarstvennyj Univ., Ukrainian SSR). Nov 1984. (In Bulgarian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

22217 **(N—88-13411) Organic molecules on meteoritic solid substrates. Final report, 1 June 1983-31 March 1987.** Sweeney, M.A. (Santa Clara Univ., CA (USA)). Jan 1988. 20p. (NASA-CR—181570; NAS—1.26:181570). NTIS, PC A03/MF A01.

The production of C1-C3 monocarboxylic acids from carbonaceous meteorites was investigated by the radiolysis of air-free CO_2 and alkane solutions, utilizing a Cs-137 gamma-ray source. Samples were first loaded on a vacuum system, irradiated, and then analyzed by the Hewlett Packard model 5890A gas chromatograph. Moreover, the samples were irradiated with and without added ferrous iron.

22218 **Direct ionization effects of purine derivatives: ESR and ENDOR studies of 5'GMP.** Nelson, W.H.; Close, D.M.; Sagstuen, E.; Hole, E.O. (Georgia State Univ.). pp 93 of Thirty-fifth annual meeting of the Radiation Research Society (Abstracts). Philadelphia, PA; Radiation Research Society (1987). (CONF-870221—).

From 35. annual meeting of the Radiation Research Society; Atlanta, GA, USA (22 Feb 1987).

In this study the free acid of 5' GMP was investigated (in the form of 5'GMP.3H/sub 2/O crystals). Irradiation and study of the molecular system below 10K gave evidence for at least three products in the ESR. Product I was also studied by ENDOR, and has been tentatively identified as the result of the anion protonated at 06. From the experimental data the spin distribution in product I is: 30% at C8; 12% at N1; 10% at N7. Product II was identified from its characteristic ESR as the result of hydrogen addition at C8. Product III was evident in the ESR but has not yet been identified.

4007 Radiochemistry And Nuclear Chemistry

REFER ALSO TO CITATION(S) 21050, 21053, 21957, 21964, 22213, 23617

22219 **(CIEMAT—593) Preparation of 19 iodocholesterol labelled with /sup 125/I.** Rebollo, D.V.; Rodriguez Barquero, L.; Ruiz Albusac, J.M. (Centro de Investigaciones Energeticas, Medioambientales y Tecnologicas, Madrid (Spain)). 1986. 20p. (In Spanish). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700945/JAW.

A new method of synthesis of 19-iodocholesterol labelled with /sup 125/I from commercial cholesterol is described. Its high chemical (96%) and radiochemical (99,9%) purities high yield and short time of preparation permit us to dispose or a more accessible labelled compound, which results appropriate for clinical investigations and in the diagnosis of disturbances of the suprarenal glands. (author). 2 figs., 9 refs.

22220 **(DOE/ER/13469—T1) Research in chemical kinetics: Progress report, October 1, 1986-August 1, 1987.** Rowland, F.S. (California Univ., Irvine (USA). Dept. of Chemistry). 1987. Contract FG03-86ER13469. 35p. NTIS, PC A03. Order Number DE88006265/JAW.

The reactions of thermalized (using CF_4 or Kr) tritium atoms with alkylsilanes were studied. Yields of tritium-labelled and substitution products were determined. Reaction rates for thermal ^{38}Cl atoms with CH_3OH, OCS, CH_3Cl, and other compounds were measured. 20 refs., 6 figs., 11 tabs. (DLC)

22221 **(JAERI-M—86-188) Simple ion-exchange system for transplutonium elements synthesized by heavy-ion bombardments.** Usuda, S.; Shinohara, N. (Japan Atomic Energy Research Inst., Tokyo). Jan 1987. 25p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87702959/JAW.

A simple system was developed for rapid ion-exchange separation followed by source preparation for alpha counting, which is applicable for various kinds of solvent (such as strong acids and organic solvents) at a given temperature (up to 120°C) and pressure (up to 4 MPa). By use of the system, ^{250}Fm ($T_12/$: 30 min) and ^{246}Cf ($T_12/$: 35.7 hr) synthesized by the $^{16}O + ^{238}U$ reaction were separated quantitatively from a uranium target and an aluminium catcher foil. This report deals with the outline of the system and its application, and contains as appendixes manuals for the system preparation and handling.

22222 (JINR—R-7-86-322, pp 84) **Preparation of a short living /sup 123/I isotope using MT-22 microtron.** Flerov, G.N.; Oganesyan, Yu.Ts.; Belov, A.G.; Starodub, G.Ya. 1986. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780065/JAW.

In Heavy ion physics - 1985. Collection of annotations of the Nuclear Reaction Laboratory of the Joint Nuclear Research Institute works, 1985.

22223 (JINR—R-7-86-322, pp 28) **Selective sorption of transuranium and rare earth elements on phosphates from strong acid solutions.** Korotkin, Yu.S.; Li Pak Ser. 1986. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780065/JAW.

In Heavy ion physics - 1985. Collection of annotations of the Nuclear Reaction Laboratory of the Joint Nuclear Research Institute works, 1985.

22224 (JINR—R-7-86-322, pp 29) **Mendelevium isolation from mixtures of products of nuclear reactions with heavy ions.** Buklanov, G.V.; Gorski, B.; Zen Zin Pkhar. 1986. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780065/JAW.

In Heavy ion physics - 1985. Collection of annotations of the Nuclear Reaction Laboratory of the Joint Nuclear Research Institute works, 1985.

22225 (JINR—R-7-86-322, pp 15) **Search of α-isotopes of element 108 in reaction /sup 249/Cf + /sup 22/Ne with express chemical separation.** Chepigin, V.I.; Zhujkov, B.L.; Ter-Akop'yan, G.M.; Zvara, I. 1986. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780065/JAW.

In Heavy ion physics - 1985. Collection of annotations of the Nuclear Reaction Laboratory of the Joint Nuclear Research Institute works, 1985.

22226 (JINR—R-7-86-322, pp 24) **Experiments in search of superheavy elements in thermal waters of Baikal rift zone.** Dmitriev, S.N.; Azarov, V.A.; Bazarkina, T.V.; Drobina, T.P.; Krasnov, A.V.; Lebedev, V.Ya.; Shishkin, S.V. 1986. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780065/JAW.

In Heavy ion physics - 1985. Collection of annotations of the Nuclear Reaction Laboratory of the Joint Nuclear Research Institute works, 1985.

22227 (JINR—R-7-86-322, pp 25) **Experiments on concentration of spontaneous fisssion nuclide from thermal brines of Cheleken peninsular.** Dmitriev, S.N.; Azarov, V.A.; Drobina, T.P.; Krasnov, A.V.; Lebedev, V.Ya.; Pokrovskij, V.K.; Shishkin, S.V. 1986. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780065/JAW.

In Heavy ion physics - 1985. Collection of annotations of the Nuclear Reaction Laboratory of the Joint Nuclear Research Institute works, 1985.

22228 (JINR—R-7-86-322, pp 26) **Potentialities of chemical identification of short living isotopes of element 108.** Zhujkov, B.L.; Kruz, Kh.; Zvara, I. 1986. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780065/JAW.

In Heavy ion physics - 1985. Collection of annotations of the Nuclear Reaction Laboratory of the Joint Nuclear Research Institute works, 1985.

22229 (JINR—R-7-86-322, pp 31) **Behaviour of possible analogs of superheavy elements and other microelements during coal combustion.** Flerov, G.N.; Maslov, O.D.; Gavrilov, K.A.; Nguen Fyong Nam. 1986. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780065/JAW.

In Heavy ion physics - 1985. Collection of annotations of the Nuclear Reaction Laboratory of the Joint Nuclear Research Institute works, 1985.

22230 **(JINR—R-7-86-322) Heavy ion physics - 1985. Collection of annotations of the Nuclear Reaction Laboratory of the Joint Nuclear Research Institute works, 1985.** (Joint Inst. for Nuclear Research, Dubna (USSR)). 1986. 84p. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780065/JAW.

Individual papers have been indexed separately. (WRF)

22231 **(UJV—7962-B) /sup 211/At - analysis of application possibilities.** Sistkova, N. (Ustav Jaderneho Vyzkumu CSKAE, Rez (Czechoslovakia)). Mar 1987. 17p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701710/JAW.

Direct and indirect methods are presented of producing the /sup 211/At isotope. For conditions at the Nuclear Research Insti-

tute in Rez, the most suitable reaction is /sup 209/Bi(α,2n)/sup 211/At. Alpha particles are accelerated using a U-120-M cyclotron to 20-40 MeV. Briefly described is the preparation of labelled compounds from the groups of pyrimidines, steroids, amino acids, proteins and monoclonal antigens. Experience using these labelled compounds in biological in vivo and in vitro experiments and the possibility of their applications in nuclear medicine are discussed. (E.S.). 1 tab., 2 figs., 64 refs.

22232 **Preparation and crystal structures of complexes of $U(BH_3CH_3)_4$ with 1,2-dimethoxyethane, N,N,N′,N′-tetramethylethylenediamine, and 1,2-bis(methylthio)ethane.** Shinomoto, R.; Zalkin, A.; Edelstein, N.M.; Zhang, D. (Lawrence Berkeley Lab., CA). *Inorganic Chemistry;* **26**: No. 17, 2868-2872(26 Aug 1987). Contract AC03-76SF00098.

Complexes of $U(BH_3CH_3)_4$ with $CH_3OCH_2CH_2OCH_3$, $(CH_3)_2NCH_2CH_2N(CH_3)_2$, and $CH_3SCH_2CH_2SCH_3$ have been synthesized and their molecular structures determined by single-crystal X-ray diffraction. $U(BH_3CH_3)_4$ x $CH_3OCH_2CH_2OCH_3$ is tetragonal, P4/n, with a = 21.822 (8) A, c = 7.681 (5) A, Z = 8, d = 1.61 g/cm^3, and R = 0.028 [$F^2 > 3\sigma(F^2)$]; $U(BH_3CH_3)_4$ x $(CH_3)_2NCH_2CH_2N(CH_3)_2$ is monoclinic, $P2_1/n$, with a = 10.206 (4) A, b = 15.436 (6) A, c = 12.880 (5) A, β = 92.25 (3)°, Z = 4, d = 1.54 g/cm^3, and R = 0.029 ($F^2 > 3\sigma(F^2)$); $U(BH_3CH_3)_4$ x $CH_3SCH_2CH_2SCH_3$ is triclinic, P anti 1, with a = 8.937 (4) A, b = 13.692 (4) A, c = 8.186 (3) A, α = 96.46 (4)°, β = 97.64 (4)°, γ = 74.07 (4)°, Z = 2, d = 1.66 g/cm^3, and R = 0.023 ($F^2 > 2\sigma(F^2)$). With one exception, all BH_3CH_3 groups are coordinated to the uranium atoms by tridentate hydrogen bridges with a U-B bond distance of 2.55 +/- 0.02 A. For the $(CH_3)_2NCH_2CH_2N(CH_3)_2$ complex one B atom is coordinated to the uranium atom through a bidentate hydrogen bridge with a U-B distance of 2.72 (2) A and a U-B-C angle of 142 (2)°. Uranium is coordinated to the O, N, and S atoms of the respective ligands with U-O, U-N, and U-S average distances of 2.58 +/- 0.04, 2.73 +/- 0.01, and 3.07 +/- 0.04 A, respectively.

4008 Combustion, Pyrolysis, And High-temperature Chemistry

22233 **(N—88-13428) Detailed mechanism of toluene oxidation and comparison with benzene.** Bittker, D.A. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1988. 26p. (NASA-TM—100261; E—3889; NAS—1.15:100261; CONF-880802—). NTIS, PC A03/MF A01.

From 22. international symposium on combustion; Seattle, WA, USA (14 Aug 1988).

A detailed mechanism for the oxidation of toluene in both argon and nitrogen dilutents is presented. The mechanism was used to compute experimentally ignition delay times for shock-heated toluene-oxygen-argon mixtures with resonably good success over a wide range of initial temperatures and pressures. Attempts to compute experimentally measured concentration profiles for toluene oxidation in a turbulent reactor were partially successful. An extensive sensitivity analysis was performed to determine the reactions which control the ignition process and the rates of formation and destruction of various species. The most important step was found to be the reaction of toluene with molecular oxygen, followed by the reactions of hydroperoxyl and atomic oxygen with benzyl radicals. These findings contrast with the benzene oxidation, where the benzene-molecular oxygen reaction is quite unimportant and the reaction of phenyl with molecular oxygen dominates. In the toluene mechanism the corresponding reaction of benzyl radicals with oxygen is unimportant. Two reactions which are important in the oxidation of benzene also influence the oxidation of toluene for several conditions. These are the oxidations of phenyl and cyclopentadienyl radicals by molecular oxygen. The mechanism presented successfully computes the decrease of toluene concentration with time in the nitrogen diluted turbulent reactor. This fact, in addition to the good prediction of ignition delay times, shows that this mechanism can be used for modeling the ignition and combustion process in practical, well-mixed combustion systems.

22234 **(PB—88-156690/XAB) Compilation of chemical kinetic data for combustion chemistry. Part 2. Non-aromatic C, H, O, N, and S containing compounds (1983).** Westley, F.; Herron, J.T.; Cvetanovic, R.J. (National Bureau of Standards, Washington, DC (USA). Chemical Kinetics Div.). Dec 1987. 143p. (NBS/NSRDS—73/2). NTIS, PC A07/MF A01.

Also available from Supt. of Docs. as SN003-003-02830-4. See also PB—88-115761; Library of Congress catalog card No. 87-20244.

Chemical-kinetic data for reactions of importance in combustion chemistry are compiled. Experimental, theoretical, evaluated, or estimated rate constants are given for reactions of O, O_3, H, H_2, OH, HO_2, H_2O, N, N_3, NO, NO_2, N_2O, NH, NH_2, SH, H_2S, SO, SO_2, and the aliphatic, alicyclic, and heterocyclic saturated and unsaturated C1 to C15 hydrocarbons, alcohols, aldehydes, ketones, thiols, ethers, peroxides, amines, amides, and their free radicals. The data were taken from the literature published in 1983. Data omitted from Part 1 of the series, covering the period 1971 to 1982, are also included.

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REFER ALSO TO CITATION(S) 21959

22235 **(AGARD-CAL—87/1) Calendar of selected aeronautical and space meetings.** (Advisory Group for Aerospace Research and Development, 92 - Neuilly-sur-Seine (France)). Jul 1987. 144p. (In several languages). NTIS, PC A07/MF A01.

Three kinds of events are presented by the calendar: technical meetings, conferences, and synposia; exhibitions and technical displays; and educational courses. For each meeting, exhibition, or course, the following information is given: reference number, date, location, title and sponsor, keywords indicating main topics covered; and contact code for inquiries. The list of topics include: aerospace medicine and biology; electronics, optic, and metrology; flight mechanics; fluid dynamics and acoustics; navigation, guidance, and control; thermodynamics, combustion, propulsion and energetics; structures, materials, and applied mechanics; atmospheric physics and earth environment; information, documentation, and data processing; exhibitions and displays; and educational courses.

22236 **(N—88-14855) National Aeronautics and Space Administration (NASA)/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1987. Volume 1.** Jones, W.B.; Goldstein, S.H. (National Aeronautics and Space Administration, Houston, TX (USA). Lyndon B. Johnson Space Center). Nov 1987. 326p. (NASA-CR—172009-VOL-1; NAS—1.26:172009-VOL-1). NTIS, PC A15/MF A01.

The objective of the NASA/ASEE program were: (1) to further the professional knowledge of qualified engineering and science faculty members; (2) to stimulate an exchange of ideas between participants and NASA; (3) to enrich and refresh the research and teaching activities of participants' institutions; and (4) to contribute to the research objectives of the NASA centers. Each faculty fellow spent 10 weeks at Johnson Space Center engaged in a research project commensurate with his/her interests and background and worked in collaboration with a NASA/JSC colleague. A compilation is presented of the final reports on the research projects done by the fellows during the summer of 1987. This is volume 1 of a 2 volume report.

22237 **(N—88-14874) National Aeronautics and Space Administration (NASA)/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1987. Volume 2.** Jones, W.B. Jr.; Goldstein, S.H. (National Aeronautics and Space Administration, Houston, TX (USA). Lyndon B. Johnson Space Center). Nov 1987. 332p. (NASA-CR—172009-VOL-2; NAS—1.26:172009-VOL-2). NTIS, PC A15/MF A01.

The 1987 Johnson Space Center (JCS) National Aeronautics and Space Administration (NASA)/American Society for Engi-

neering Education (ASEE) Summer Faculty Fellowship program was conducted by Texas A and M University and JSC. The 10-week program was operated under the auspices of ASEE. The basic objectives of the program are: to further the professional knowledge of qualified engineering and science faculty members; to stimulate an exchange of ideas between participants and NASA; to enrich and refresh the research and teaching activities of participants' institutions; and to contribute to the research objective of the NASA Centers. This document is a compilation of the final reports on the research projects done by the faculty fellows during the summer of 1987.

22238 **(UCRL—50016-87-1) Mechanical Engineering: Technical abstracts for the period January-June 1987.** Woo, H.H. (ed.). (Lawrence Livermore National Lab., CA (USA)). Nov 1987. Contract W-7405-ENG-48. 38p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88006561/JAW.

Twice a year Mechanical Engineering at the Lawrence Livermore National Laboratory publishes Technical Abstracts to inform readers of the broad range of technical activities conducted in the discipline and to promote an exchange of ideas. This report covers the period January through June 1987 and contains 73 abstracts.

22239 **(AD-A—186823/1/XAB) National standard catalog (selected pages).** (Air Force Systems Command, Wright-Patterson AFB, OH (USA). Foreign Technology Div.). 11 Sep 1987. Trans. of Guodjia Biaozhun Mulu (China) p216, 243-271, 272-310, 311-325, 326-335(1984). (FTD-ID(RS)T—0421-87). 187p. NTIS, PC A09/MF A01.

This Chinese translation provides a listing, arranged in numerical order, of the titles of Chinese standards in: Nuclear energy technology, Chemical engineering, Metallurgy, Machinery, Electrical engineering, Electronic computer technology, and Broadcasting communications, Draft, revision, and implementation dates are included.

4202 Facilities And Equipment

REFER ALSO TO CITATION(S) 20789, 20936, 20943, 21035, 21055, 21362, 21593, 21660, 21978, 22018, 22364, 22373, 22405, 23359, 23360

22240 **(AD-A—186932/0/XAB) Contamination hazard of secondary vapor in a collective shelter resulting from entry/exit operation. Technical report, January-April 1986.** Birenzvige, A. (Chemical Research, Development and Engineering Center, Aberdeen Proving Ground, MD (USA)). Sep 1987. 22p. (CRDEC-TR—87074). NTIS, PC A03/MF A01.

A theoretical study of the effects of entry/exit procedures on the vapor hazard inside an NBC shelter was developed. The model assumes that soldiers will doff their contaminated overgarments in a vapor-rich environment where some vapor can adsorb on their undergarments or skin. When the soldiers enter the air lock, some of the vapor desorbs. The model calculates the time history of agent concentration in the air lock and shelter. The model can be used to evaluate design criteria for chemical shelters and operational procedures for processing personnel through the shelter.

22241 **(ANL/CNSV—64) Advances in applied superconductivity: A preliminary evaluation of goals and impacts.** Wolsky, A.M.; Daniels, E.J.; Giese, R.F.; Harkness, J.B.L.; Johnson, L.R.; Rote, D.M.; Zwick, S.A. (Argonne National Lab., IL (USA)). Jan 1988. Contract W-31109-ENG-38. 171p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE88006441/JAW.

This document is meant to aid the US Department of Energy, Assistant Secretary for Conservation and Renewable Energy by discussing the likely impacts of recent results from research on superconducting materials. The discussions in this document concern terrestrial applications that would substantially affect the production and use of electricity. The sections of the report each address a particular topic. The topics are: (1) electric generators, (2) transformers, (3) power transmission, (4) magnetic energy storage, (5) electric motors, (6) separation industry, and (7) maglev trains. (JDH)

22242 **(BAE-TP—8095-VOL-1) Evaluation of a cryogenic refrigerator for cooling focal plane instrumentation. Final report.** Joseph, B.; Werrett, S.T.; Lowe, H. (British Aerospace Dynamics Group, Bristol (UK)). May 1986. 147p. (ESA-CR(P)—2424-VOL-1; ETN—88-90884). NTIS, PC A07/MF A01.

The design and performance of a miniature Stirling cycle refrigerator for cooling focal plane instrumentation on ERS and meteorological satellites are described. The accomodation within and the interfaces with three spacecraft payloads are outlined. Causes of two failures which occurred during performance testing were investigated and modifications to prevent any recurrence were made. The design is demonstrated to be suitable for cooling small detector assemblies in a variety of space applications. Although the refrigerator was manufactured in small quantities, no major problems are foreseen with the transfer to commercial quantity production.

22243 **(BAE-TP—8095-VOL-2) Evaluation of a cryogenic refrigerator for cooling focal plane instrumentation. Appendix B: Accommodation study. Final report.** Joseph, B.; Werret, S.T.; Lowe, H. (British Aerospace Dynamics Group, Bristol (UK)). May 1986. 155p. (ESA-CR(P)—2424-VOL-2; ETN—88-90885). NTIS, PC A08/MF A01.

It is shown that a miniature Stirling cycle refrigerator can be used to cool an ocean color monitor (OCM) and an optical imaging instrument (OII) on an Earth resources satellite, and an infrared scanner for a meteorological satellite. In the most demanding requirement, cooling the OII detectors, the cooler can cope with a requirement which is impracticable with passive cooling. With less demanding configurations (OCM detectors) adequate spare capacity should be available to permit consideration of detector redundancy provisions. The main requirement of the cooler is for up to 75 W raw electrical power input. That is a two compressor/displacer combination including all control and drive electronics. Study of potential advanced Meteosat requirements shows that accommodation is likely to be easier on a three-axis stabilized spacecraft than on a spin stabilized one.

22244 **(BMU—1987-167) Fracture mechanical analysis of operational damaged piping. Supporting work by GRS (SR 271/3) on the 'Degraded Piping Program' of USNRC. Numerical simulation of the crack arrest tests to verify the dynamic J-integral formulation.** Azodi, D. (Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany, F.R.); Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). 1987. 44p. (In German). (GRS-A—1339). GRM Werbeberatung - Werbemittlung - PR, Eggenstein-Leopoldshafen,, Germany, F.R.

Schriftenreihe Reaktorsicherheit und Strahlenschutz. Ergebnisberichte, Untersuchungen, Studien, Gutachten.

A series of crack arrest experiments by means of transverse wedge-loaded compact specimen was simulated numerically to verify the dynamic J-integral formulation, for applications in brittle and ductile regions as well as for two- and three-dimensional geometries. The transverse wedge-loaded compact crack arrest test is a widely used small scale test to evaluate the crack arrest toughness of nuclear pressure vessel steels. In this test method the crack attains a high velocity after initiation, then decelerates to a low velocity prior to arrest. The opening displacement remains constant during the crack propagation. Crack extension and the opening displacement behaviour were measured using a sensitive time scale. Regarding material toughness two entirely different kind of steels, HFX 760 (brittle) and 20 MnMoNi 55 (ductile) were considered. The testing temperature was the room temperature. The numerical analyses were performed by an extended version of the finite element code ADINA. Crack propagation was simulated by 'node shift and fixity release' procedure. Discussions in this report are, among others, directed to the: Numerical stability of different J-integral contours during the fast crack propagation and comparison between the static approach, dynamic finite element analyses and experimental results for crack initiation toughness and arrest toughness. The numerical simulation results and experimental data were in close agreement. The achieved results confirm that the dynamic J-integral formulation is able to describe the rapid crack propagation and the crack arrest in steel components sufficiently.

22245 **(BN-SA—1642) Hazardous material transportation risks in the Puget Sound Region.** Andrews, W.B.; Rhoads, R.E.; Franklin, A.L.; Cole, B.M.; Rau, R.G. (Battelle Pacific Northwest Lab., Richland, WA (USA)). [1981]. Contract AC06-76RL01830. 15p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006191/JAW.

This paper summarizes results of a study performed for the Transportation Systems Center (TSC) of the US Department of Transportation (DOT), to determine public safety risks of transporting hazardous material (HM) in the Central Puget Sound Region (CPSR) of Washington State. Results of this study were used in a regional assessment of hazardous material transportation conducted for the Materials Transportation Bureau (MTB) of DOT by the Puget Sound Council of Governments (PSCOG) and the DOT Transportation Systems Center (TSC). Additional hazardous material studies have also been conducted by the DOT in New Orleans, Louisiana, San Francisco, California, Niagara County, New York, Indianapolis, Indiana, Memphis, Tennessee, and the State of Massachusetts. 15 refs., 2 figs., 6 tabs.

22246 **(CEA-CONF—8977) Observation of radioactive materials machining on a digital lathe in a glove box.** Pic, F. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92 - Montrouge (France)). Mar 1987. 22p. (In French). (CONF-8703242—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88752146/JAW.

From SFRP meeting on ergonomics and protection; Paris, France (12 Mar 1987).

Observations of a physician are gathered in this paper. After a description of the operation, the frequency for use of gloves, the look direction and areas that are reached in the glovebox.

22247 **(CEA-CONF—9004) Conception of packing for transport of liquid radioactive effluents.** Leconnetable, J.; Vialettes, H. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Protection contre les Rayonnements). Oct 1986. 17p. (In French). (SPR-S-IDS—86-519; CONF-8610337—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88752133/JAW.

From SFRP meeting on mastering of a transport system for dangerous materials; Paris, France (7 Oct 1986).

After a brief recall of legislation, the authors give the main characteristics of the 3 vehicles used by the radiation protection of CEN-Saclay, for transport of liquid radioactive effluents. They are: - LR54 for low radioactivity, - LR56 for medium and high radioactivity, - LR44 for high and very high radioactivity.

22248 **(CONF-870873—26) Preparation of large area NbN/AlN/NbN Josephson junctions.** Song, S.N.; Jin, B.Y.; Yang, H.Q.; Ketterson, J.B.; Schuller, I.K. (Northwestern Univ., Evanston, IL (USA); Argonne National Lab., IL (USA)). Dec 1987. Contract W-31109-ENG-38. 3p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88006074/JAW.

From 18. conference on low temperature physics; Kyoto, Japan (20 Aug 1987).

AlN has been used as a barrier material in large Josephson junctions. The chemical and structural compatibility of AlN with NbN make it possible to fabricate NbN/AlN/NbN junctions by sequential reactive sputtering in a common Ar and N_2 atmosphere. In a junction with an area of about 1.0 x 1.0 mm^2, having a transition temperature of 14.5K, the measured I-V and first derivative curves yield a sum gap value of about 3.0 MeV. 9 refs., 3 figs.

22249 **(CONF-871125—21) A novel method for sputter-deposition of high T/sub c/ superconductor films via a computer-controlled mass analyzed ion beam.** Auciello, O.; Krauss, A.R. (North Carolina State Univ., Raleigh (USA). Dept. of Nuclear Engineering; Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88006001/JAW.

From 34. national vacuum symposium and topical conference; Anaheim, CA, USA (2 Nov 1987).

A novel concept is demonstrated for ion beam sputter-induced deposition of high T/sub c/ superconductor films. The concept involves the use of a well-focused ion beam which can be sequentially directed via a set of x-y electrostatic deflection plates onto three or more different elemental or compound target which are constituents of the desired composite film. The deflection plates are driven by two +-1000 volt bipolar programmable power supplies which are controlled by a DEC LSI 11/73 computer. A custom program drives two D/A converters to provide the +-10 volt analog signal which is used to drive the power supplies in such a way that the ion beam is positioned on selected spots on the different targets. By programming the dwell time for each target according to the known sputtering yield and desired layer thickness for each material, it is possible to deposit composite films from a well-controlled sub-monolayer up to thicknesses determined only by the available deposition time. Initial results on the deposition of Y-Ba-CuO films are presented to demonstrate the concept, which in principle can also be applied to the deposition of high T/sub c/ superconducting films by electron- and laser-induced evaporation of elemental or oxide targets. 26 refs., 5 figs.

22250 **(CONF-871167—2) High-T/sub c/ superconducting wire fabrication and testing.** Capone, D.W. II; Dusek, J.T.; Goretta, K.C. (Argonne National Lab., IL (USA)). Oct 1987. Contract W-31109-ENG-38. 12p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88005989/JAW.

From 36. international wire and cable symposium; Arlington, VA, USA (17 Nov 1987).

This paper describes the fabrication of ceramic fibers of the high-T/sub c/ superconductor $YBa_2Cu_3O_7$ and the testing procedures used to characterize these materials. The major factors important to the fabrication of these fibers are described in general terms including some of the issues relating to the strength and flexibility of the wires. Measurements of the three parameters which most easily characterize the superconducting properties of the fibers, T/sub c/, H/sub c2/, and J/sub c/, are described, particularly the critical current density, J/sub c/. 19 refs.

22251 **(CONF-880461—1) Investigation of aeroacoustic mechanisms by remote thermal imaging.** Witten, A.J.; Courville, G.E. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 15p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002612/JAW.

From 10. thermosense conference; Orlando, FL, USA (4 Apr 1988).

A hush house is a hangar-like structure designed to isolate, from the surrounding environment, the noise produced by extended aircraft engine operations during diagnostic testing. While hush houses meet this intended need by suppressing audible noise, they do emit significant subaudible acoustic energy which has caused structural vibrations in nearby facilities. As a first step in mitigating the problems associated with hush house induced vibrations, it is necessary to identify the mechanism responsible for the low frequency acoustic emissions. It was hypothesized that the low frequency acoustic waves are a result of acoustic Cherenkov radiation. This radiation is in the form of a coherent wave produced by the engine exhaust gas flow. The speed of sound in the exhaust gas is quite high as a result of its elevated temperature. Therefore, the gas flow is sonic or subsonic relative to its own sound speed, but is supersonic relative to sound speed in the surrounding cooler air and, as a result, produces acoustic Cherenkov radiation. To confirm this hypothesis, thermographic surveys were conducted to image the thermal structure of the engine exhaust gas within the hush house. In the near-field, these images revealed that the exhaust gases did not behave like a high Reynolds number turbulent jet, but rather, the transition to turbulence is delayed by a suppression in growth of the self-excited instability wave as a result of acoustic Cherenkov radiation. 4 refs., 7 figs.

22252 **(CONF-880462—2) Concurrent algorithms for a mobile robot vision system.** Jones, J.P.; Mann, R.C. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 9p. (CESAR—88/06). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005850/JAW.

From SPIE's technical symposium on optics, electro-optic and sensors; Orlando, FL, USA (4 Apr 1988).

The application of computer vision to mobile robots has generally been hampered by insufficient on-board computing power.

The advent of VLSI-based general purpose concurrent multiprocessor systems promises to give mobile robots an increasing amount of on-board computing capability, and to allow computation intensive data analysis to be performed without high-bandwidth communication with a remote system. This paper describes the integration of robot vision algorithms on a 3-dimensional hypercube system onboard a mobile robot developed at Oak Ridge National Laboratory. The vision system is interfaced to navigation and robot control software, enabling the robot to maneuver in a laboratory environment, to find a known object of interest and to recognize the object's status based on visual sensing. We first present the robot system architecture and the principles followed in the vision system implementation. We then provide some benchmark timings for low-level image processing routines, describe a concurrent algorithm with load balancing for the Hough transform, a new algorithm for binary component labeling, and an algorithm for the concurrent extraction of region features from labeled images. This system analyzes a scene in less than 5 seconds and has proven to be a valuable experimental tool for research in mobile autonomous robots. 9 refs., 1 fig., 3 tabs.

22253 **(DOE/ER/13382—T1) A chemical method for achieving acceleration of macroparticles to ultrahigh velocities: Final report, 1 June 1985-30 April 1987.** Hertzberg, A.; Bruckner, A.P.; Mattick, A.T.; Bogdanoff, D.W.; Brackett, D.C.; McFall, K.A. (Washington Univ., Seattle (USA). Aerospace and Energetics Research Program). 1987. Contract FG06-85ER13382. 158p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE88006377/JAW.

This report describes work performed for the Department of Energy over the time period 1 June 1985 to 30 April 1987. The main areas of investigation are computational studies of gas and high explosive driven ramjet-in-tube concepts over the velocity range 3 - 20 km/sec, linear velocity multiplication over the velocity range 7 - 100^{+} km/sec and radiation emitted from impacts at closing velocities of 80 - 400 km/sec. This report presents the computational methods used, including benchmark proof tests of these methods, as well as results of the investigations. 41 refs., 62 figs., 11 tabs.

22254 **(DOE/ER/13673—T1) Fundamental studies of fluid mechanics and stability in porous media: Progress report.** Homsy, G.M. (Stanford Univ., CA (USA)). 1987. Contract FG03-87ER13673. 3p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005903/JAW.

We have been active in three areas of research over the last grant period. These are experimental studies of immiscible viscous fingering, and numerical simulation of both miscible and immiscible viscous fingering. 4 refs.

22255 **(DOE/OR/00033—T384) The DOE University Research Instrumentation Program: Assessment of continuing need.** (Oak Ridge Associated Universities, Inc., TN (USA)). Dec 1987. Contract AC05-76OR00033. 75p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88006081/JAW.

Universities play an essential role in maintaining and extending the science and technology base in the US. Their ability to continue making significant contributions increasingly depends on faculty and student access to modern instruments that are critical to the performance of research and development. The level of sophistication of academic equipment has an unmistakable effect on the quality of scientific research and education. With this in mind, the US Department of Energy (DOE) cooperates in an interagency effort to upgrade the quality of university instrumentation through its University Research Instrumentation (URI) program. Begun in FY1984, this program has supported 94 awards totaling an excess of $19.5 million. The purpose of this report is to review the early accomplishments of the Department of Energy University Research Instrumentation Program and to assess the continuing need for university equipment to support energy-related research on campus. This is done through a careful examination of the DOE URI program, its relationship to the instrumentation programs of other agencies, and the combined impact of the programs on university equipment needs. The DOE URI program is shown to have an impact on science and engineering education and academic research. It fills needs not otherwise addressed by supporting the acquisition of specific instruments required for energy-related research and training. In spite of URI's success, the need for academic equipment continues. It is found that between $4 million and $8 million must be provided annually to maintain the current infrastructure of equipment in the $100,000 to $1 million range necessary to support energy-related activities on campus. 23 refs., 4 figs., 12 tabs.

22256 **(DP-MS—87-132) OCR vision system, an alternative to bar code.** Leader, D.R. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). 2 Nov 1987. Contract AC09-76SR00001. 7p. (CONF-880458—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003761/JAW.

From I.D. expo; Boston, MA, USA (20 Apr 1988).

This report describes optical character reader system advantages and applications. Comparisons are made to bar code readers. (JDH)

22257 **(EFI—937(88)-86) Dilution refrigerator with non-valve adsorption system of /sup 3/He circulation.** Aroyan, A.A.; Arutyunyan, M.A.; Mina, R.T.; Boldarev, S.T.; Mishachev, V.M.; Amamchyan, R.G. (Erevanskij Fizicheskij Inst. (USSR)). 1986. 16p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700974/JAW.

For the first time a two stage continuous action dilution refrigerator was constructed based on a non-valve adsorption system of /sup 3/He pumping, as an upper stage. The minimum temperature of the lower (dilutional) stage was $\sim$ 0.2 K. The interrelation of the lower and upper refrigerator stages at different /sup 3/He circulation rates in the lower was studied. Some essential characteristics of the condensation pump dependence on temperature of still and mixing chamber were calculated and the ways to refrigerator development were determined. The presence of transfer over the superfluid /sup 4/He film in dilution refrigerators with condensation pumping and its influence on the parameters of refrigerator were discussed. 11 refs.; 2 figs.

22258 (INIS-SU—441, pp 39-42) **Helium cryopumping in the cryotrapping regime.** Kryukov, A.P.; Sidorov, E.V. 1987. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88780051/JAW.

Voprosy Atomnoj Nauki i Tekhniki.; no. 1.

In Thermonuclear synthesis.

The paper deals with experimental investigation of helium cryotrapping by nitrogen during nitrogen condensation to cryopanel possessing temperature of liquid helium. Three characteristic parts are distinguished on curves of pressure dependence on time: sharp pressure growth in initial moment, pressure drop, the part of pressure, constant in time or the part of stationary cryotrapping. It is shown that initial pressure growth can be moderated or suppressed completely by preliminary formation of sorbent layer on cryopannel surface. Application of this sorbent enables to simplify the design of cryovacuum pump and regeneration, improve thermal contact of the sorbent with cryopanel, to automize operation conditions, provide large hydrogen and helium absorptivity.

22259 **(JINR—13-85-835) Valve for high pressure up to 10 kbar.** Bystritskij, V.M.; Stolupin, V.A.; Granovskij, V.B.; Kuts, V.A.; Chibisov, A.N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems; AN Ukrainskoj SSR, Kiev. Inst. Geokhimii i Fiziki Mineralov). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1985. 3p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701652/JAW.

Submitted to the journal Instrum. Exp. Tech. .

A valve designed for both gas and liquid operation at a pressure up to 10 kbar is described. The valve is controlled by a hydraulic drive with the effort transferred to the closing needle. This alloys the valve to be used in highly radiative systems. The needle reverse running is provided by disc springs. The valve designs guarantees a high degree of operational reliability. 4 refs.; 1 fig.

22260 **(K—2057-Rev.1) Renovation of DOT specification 21PF-1 protective shipping packages.** Barlow, C.R.; Ziehlke, K.T.; Pryor, W.A.; Housholder, W.R. . (Oak Ridge National Lab., TN (USA)). 21 Nov 1986. Contract AC05-84OT21400. 25p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005487/JAW.

Protective shipping packages for isotopically enriched uranium hexafluoride show deterioration with extended service, principally, structural damage from rough handling, and rust damage from exposure to weather and from storage practices which may promote absorption of water by the insulating foam. This report summarizes and references work which has been done to evaluate the integrity of the phenolic foam insulation in used shipping packages and outlines the process developed for drying the foam prior to rework of the containers. Mechanical and thermal properties of the foam are not adversely affected by the presence of limited amounts of water, nor are they degraded by the removal process. Rework of the packages, however, must be preceded by moisture removal to slow or avoid continuing rust damage, and tests have shown that drying can be effected by heating at 190°F and above for periods of three days or more. Drying progress is monitored by weight loss and/or by use of a moisture meter. 3 refs., 6 figs., 2 tabs.

22261 **(K/D—5400-Rev.3) Safety analysis report for modified UF_6 cylinder shipping package, DOT specification 21PF-1.** McCauley, W.R. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). Dec 1986. Contract AC05-84OT21400. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005788/JAW.

The original design of the US Department of Transportation (DOT) Specification 21PF-1 overpack for 2.5-ton uranium hexafluoride (UF_6) product cylinders was prepared by Union Carbide Corporation-Nuclear Division (UCC-ND) Engineering in 1967. The Safety Analysis Report for Packaging (SARP) was prepared at that time and is included in the Oak Ridge Gaseous Diffusion Plant (ORGDP) Report K-1686, published April 13, 1967. Results of the qualifying Drop Test and Fire Test are also recorded in that document. This SARP is a supplement to the above referenced document and includes changes in design (Dwgs. attached), materials of construction, and weighing/labeling specifications.

22262 **(N—88-14379) Utilization of FEP energetics. Final report.** Frederking, T.H.K.; Abbassi, P.; Afifi, F.; Khandhar, P.K.; Ono, D.Y.; Chen, W.E.W. (California Univ., Los Angeles (USA)). Dec 1987. 66p. (NASA-CR—182373; NAS—1.26:182373; UCLA-ENG—8746). NTIS, PC A04/MF A01.

The research and development work on Fountain Effect Pump Systems (FEP systems) has been of interest in the competition between mechanical pumps for He II and FEP units. The latter do not have moving parts. In the course of the work, the energetics have been addressed using one part of a simple four-changes-of-state cycle. One option is the FEP ideal change of state at constant chemical potential (mu). The other option is the two-state sequence mu-P with a d mu=0 state change followed by an isobar. Questions of pump behavior, of flow rate response to temperature difference at the hot end, and related questions of thermodynamic cycle completion and heat transfer have been addressed. Porous media data obtained elucidate differences between vapor-liquid phase separation (VLPS) and Zero Net Mass Transfer (ZNMF).

22263 **(PB—88-856950/XAB) Protective clothing: fire and radiation environments. January 1970-January 1988 (citations from the NTIS data base). Report for January 1970-January 1988.** (National Technical Information Service, Springfield, VA (USA)). Jan 1988. 117p. NTIS PC N01/MF N01.

Supersedes PB—87-850970.

This bibliography contains citations concerning research on clothing, respirators, visors, and associated equipment for personal protection when exposed to flames or radiation. Topics include treatment of fibers and textiles, design of protective gear, testing for physiological tolerances, methods of decontamination after exposure, and acceptance of equipment for intended use. (This updated bibliography contains 245 citations, 15 of which are new entries to the previous edition.)

22264 **(PB—88-857115/XAB) Welding: personnel safety. January 1973-February 1988 (citations from Information Services in Mechanical Engineering data base). Report for January 1973-February 1988.** (National Technical Information Service, Springfield, VA (USA)). Feb 1988. 59p. NTIS PC N01/MF N01.

Supersedes PB—85-860104.

This bibliography contains citations concerning research and development of protective clothing, ventilation systems, and protective devices for welding tradespersons. Toxic substances in gas welding and shock hazards in electric welding processes are discussed. Respiratory ailments found in steel welders, radiation hazards, and worker complaints due to working postures are also considered. (This updated bibliography contains 154 citations, 31 of which are new entries to the previous edition.)

22265 **(SAND—87-1518C) Component mode synthesis using experimental modes enhanced by mass loading.** Gwinn, K.W.; Lauffer, J.P.; Miller, A.K. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 8p. (CONF-880220—15). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88006097/JAW.

From 6. international modal analysis conference; Orlando, FL, USA (1 Feb 1988).

A technique is presented for synthesis of mathematical models of structural systems using experimentally measured component modes that have been enhanced by mass interface loading. With this technique, individual components are tested with arbitrary discrete masses added to interface points. This generates mode shape vectors with increased curvature near the interface to better account for local flexibility effects, and concentrates additional flexible body modes in the measurement frequency bandwidth. The effect of the interface mass is then analytically removed before the component is assembled into the global system. Results of an analytical study, using this technique on a simple beam structure, are given that show significant improvement in predicting system modes compared to using only free-free interface modes. An example is provided which assembles the same structure using an experimentally defined component with a finite element model. Results from this study indicate significant improvement in the assembled system properties. 12 refs., 9 figs., 2 tabs.

22266 **(SAND—87-1835C) Telerobotic operation of conventional robot manipulators.** Boissiere, P.T.; Harrigan, R.W. (New Mexico Univ., Albuquerque (USA); Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 9p. (CONF-880424—8). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005718/JAW.

From IEEE international conference on robotics and automation; Philadelphia, PA, USA (25 Apr 1988).

This paper discusses a new telerobotic control concept and its implementation using a PUMA-560 robot manipulator. The control concept couples human supervisory commands with computer reasoning. The control system is responsive and accomplishes an operator's commands while providing obstacle avoidance and controlled interactions with the environment where desired. This provides a system which not only assists the operator in accomplishing tasks but modifies inappropriate operator commands which can result in safety hazards and/or equipment damage. 15 refs., 6 figs.

22267 **(SAND—87-2192C) Oscillation damped movement of suspended objects.** Jones, J.F.; Petterson, B.J. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 7p. (CONF-880424—9). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88005715/JAW.

From IEEE international conference on robotics and automation; Philadelphia, PA, USA (25 Apr 1988).

Transportation of objects using overhead cranes or manipulators can induce pendulum motion of the object. Residual oscillation from transportation typically must be damped or allowed to decay before the next process can take place. By properly programming the acceleration of the transporting device (e.g., crane) an oscillation damped transport and swing free stop is obtainable. This paper reviews the theory associated with oscillation damped trajectories for simply suspended objects and describes a particular imple-

mentation using a CIMCORP XR 6100 gantry robot. 8 refs., 7 figs., 1 tab.

22268 **(SAND—87-2255C) A hybrid transform/DPCM encoder for data compression.** Gray, S.D. (Sandia National Labs., Albuquerque, NM (USA)). 11 Sep 1987. Contract AC04-76DP00789. 23p. (CONF-880424—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE87014852/JAW.

From IEEE international conference on robotics and automation; Philadelphia, PA, USA (25 Apr 1988).

A new technique for the transmission of video is presented in this paper. It incorporates several ideas that enable a significant reduction in the data rate over a straight forward pulse code modulation (PCM) system. Theoretical expressions are presented to give a firm background in how the procedure works and what are its limitations. Although the proposed system contains a considerable amount of computational sophistication, an emphasis has been placed on portable application. To back up these ideas and allow the reader to judge the effectiveness of this procedure, several photographs are included. 6 refs., 3 figs., 2 tabs.

22269 **(UCID—21306) Studies on the testing and analysis of T156 tank-track shoes: Final report, April 1985-September 1987.** Goldberg, A.; Chinn, D.J.; Brady, R.L. (Lawrence Livermore National Lab., CA (USA)). Dec 1987. Contract W-7405-ENG-48. 57p. (MTL-TR—87-61). NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88006247/JAW.

Conceptual designs of two laboratory test systems, one for testing full-size tank-track shoes, a second for testing coupons are described. Both systems are capable of simulating the various loading scenarios experienced during tank maneuvers. Details of tests performed with the M1 tank at Yuma Proving Ground to evaluate the T156 pads are presented. A frame-by-frame analysis of movies taken of these tests was made and the results are discussed. A laboratory test system was built at LLNL to duplicate the testing performed by the Aerospace Corporation on the T142 shoes. A description of this LLNL test system together with some preliminary results obtained on testing T156 shoes are presented. Some apparent differences in the response of the T156 and T142 shoes are shown to exist. Recommendations for future studies are made. 3 refs., 32 figs.

22270 **(UCRL—15995) Design and fabrication of binary-valued alignment reticle patterns.** (Gallagher Associates, Inc., West Lafayette, IN (USA)). [May 1987]. Contract W-7405-ENG-48. 77p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88005421/JAW.

We have studied techniques for alignment reticle fabrication. Two design methods are discussed in this report: one uses an iterative procedure and the other uses results from number theory. A third method was also studied briefly; this being a binary chirp grating. Although this was described in a previous report, we did not find it particularly promising and do not discuss it in this document. It is our opinion that either of the two methods discussed in this report can be made into a workable system if there is sufficient interest. It is also our opinion that the reticle design based on number theory, which uses the polarization encoding of two patterns onto a single substrate, is a powerful method which deserves further consideration.

22271 **(UCRL—97240) The concept of an impact resonance diagram for characterizing the nonlinear response of impact vibration.** Dalrymple, T.O. (Lawrence Livermore National Lab., CA (USA)). Jan 1988. Contract W-7405-ENG-48. 17p. (CONF-880469—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005475/JAW.

From 2. international symposium on transport phenomena, dynamics, and design of rotating machinery; Honolulu, HI, USA (3 Apr 1988).

Due to part tolerances or tolerances that allow for assembly, a closed component assembly may be thought of as a closed system of independent rigid bodies, such as a system of nestled shells where a gap exists between each pair of shells. When the assembly is subjected to vertical forced excitations, such as harmonic or random vibration, the individual components will separate and move independently once the level of excitation has overcome the local gravity field. The separated bodies will move independently of one another until impact occurs, then resume independent motion with new initial velocities until the next impact, etc. By defining resonance for a closed impacting system as being "the region of harmonic driving frequency and magnitude that causes the most severe impacting" we are well on the way to constructing a resonance diagram for that system. Thus, the impact resonance diagram is a graphical tool that consists of plotting the response of an impacting system in terms of impact severity against the two independent variables of excitation frequency and excitation magnitude. The purpose of the impact resonance diagram is to have a graphical tool to quickly identify regions of excitation frequency and magnitude that will be detrimental to the system. 25 refs., 7 figs.

22272 **(UCRL—98063) Controlled component synthesis.** Young, K.D. (Lawrence Livermore National Lab., CA (USA)). Apr 1988. Contract W-7405-ENG-48. 6p. (CONF-880438—4). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88006236/JAW.

From International conference on computational engineering science; Atlanta, GA, USA (10 Apr 1988).

A new framework has been developed for structural control. The method developed herein detours from the conventional control system design path which begins with a model of the open loop plant. Instead, the controlled plant is assembled from controlled components in which the modeling phase and the control design phase are integrated at the component level. The developed method is labeled as a Controlled Component Synthesis (CCS) method to reflect that it is motivated by the well developed Component Mode Synthesis (CMS) methods - a collection of structural analysis methods which has been demonstrated to be effective for solving large complex structural analysis problems for almost three decades. The ideas behind CCS are stimulated by the subsystem decomposition viewpoint in large scale system theory on one hand, and by the component mode synthesis methods in structural analysis. In this paper, CCS is illustrated through the design of a distributed structural control system for a planar truss structure.

22273 **(WHC-EP—0003) Westinghouse Hanford Company exemption for GMR-I canister.** Bartley, P.L. (Westinghouse Hanford Co., Richland, WA (USA)). Dec 1987. Contract AC06-87RL10930. 56p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88006090/JAW.

Westinghouse Hanford Company has an infrequent need to enter areas of elevated radioiodine-131. The only respiratory protection currently approved by Mine Safety and Health Administration/National Institute for Occupational Safety and Health (MSHA/NIOSH) for entry into these areas is positive-pressure breathing air. Some of these areas also contain high levels of external and surface radiation. To reduce the additional time spent in these areas caused by wearing positive-pressure breathing devices, the use of sorbent filter respirators was evaluated. It was concluded that the proper use of a sorbent filter respirator would safely protect the wearer and minimize wearer encumbrance, thus reducing the received radiation dose. This publication applies for exemption to the MSHA/NIOSH standards in accordance with applicable Department of Energy requirements. The exemption is specifically for the use of Mine Safety Appliance (MSA) GMR-I canisters. This publication describes the program elements used to ensure safe usage of these canisters. Also included are MSA testing data. Nuclear Regulatory Commission exemption request information, and a review of possible biological effects. 8 refs., 2 figs., 10 tabs.

22274 **SCANS is an effective PC-based system for the analysis of shipping cask designs.** Nelson, T.A.; Gerhard, M.A. (Lawrence Livermore National Lab., CA, USA). pp 89-93 of Transactions of the 9th international conference on structural mechanics in reactor technology. Vol. B. Computational mechanics and computer-aided engineering. Wittmann, F.H. (ed.). Rotterdam, Netherlands; Balkema (1987). (CONF-870812—). Contract W-7405-ENG-48.

From 9. SMIRT: international conference on structural mechanics in reactor technology; Lausanne, Switzerland (17 Aug 1987).

This paper describes a micro-computer-based system of computer programs and databases called SCANS (Shipping Cask Analysis System) that was developed at the Lawrence Livermore National Laboratory (LLNL) jointly for the U.S. Nuclear Regulatory Commission (NRC) and the U.S. Department of Energy. SCANS is used to calculate the response of a nuclear spent fuel cask to impact, pressure, and thermal loads. It is useful for performing sensitivity studies and for evaluating safety analysis reports on spent fuel casks that are submitted for licensing.

22275 **Parallel processors and nonlinear structural dynamics algorithms and software.** Belytschko, T.; Gilbertsen, N.D.; Kennedy, J.M. (Northwestern Univ., Evanston, IL, USA. Dept. of Civil Engineering; Argonne National Lab., IL, USA). pp 143-148 of Transactions of the 9th international conference on structural mechanics in reactor technology. Vol. B. Computational mechanics and computer-aided engineering. Wittmann, F.H. (ed.). Rotterdam, Netherlands; Balkema (1987). (CONF-870812—).

From 9. SMIRT: international conference on structural mechanics in reactor technology; Lausanne, Switzerland (17 Aug 1987).

This paper describes the development of a nonlinear structural dynamics computer program based on explicit time integration with a library of elements which can effectively exploit a computer with concurrent processing capabilities and vectorization. This program contains a 4-node quadrilateral shell element, a beam element, and a spring element so that the allocation problem among different elements can be studied. It is a three dimensional program which treats both geometric and material nonlinearities.

22276 **Application of spherical gratings in synchrotron radiation spectroscopy.** Hogrefe, H.; Howells, M.R.; Hoyer, E. (Lawrence Berkeley Lab., Berkeley, CA). pp 274-285 of Soft x-ray optics and technology. Koch, E.E.; Schmahl, G. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-861242—). Contract AC03-76SF00098.

From International conference on soft X-ray optics and technology; West Berlin, F.R. Germany (8 Dec 1986).

The recent development in grazing incidence grating monochromator design is discussed and the performance limiting factors for such instruments are examined; especially the aberrations of toroidal and spherical gratings are investigated using the optical path function concept. It is shown that large radius spherical gratings, which can be produced with better slope tolerances than aspherics, also yield smaller overall line curvature than toroids. Therefore, a new simple spherical grating monochromator design is proposed and its performance is analyzed.

4203 Lasers

REFER ALSO TO CITATION(S) 21238, 22333, 23622, 23791

22277 **(AD-A—186952/8/XAB) Structure of the sideband spectrum in free-electron lasers. Interim report.** Riyopoulos, S.; Tang, C.M. (Naval Research Lab., Washington, DC (USA)). 19 Nov 1987. 67p. (NRL-MR—6118). NTIS, PC A04/MF A01.

The one-dimensional, fast-time averaged Hamiltonian is derived in a free-electron laser (FEL) for electrons passing through a constant parameter wiggler and a radiation field. The exact unperturbed orbits without sidebands are obtained for all particles and arbitrary separatrix height delta sub gamma. Integration, in action-angle variables, of the linearized kinetic equation with perturbing sidebands over the unperturbed orbits yields the sideband growth rate including both trapped and untrapped particles. The structure and scaling of the unstable spectrum are different from previous results obtained for electrons localized at the bottom of the ponderomotive well. Upper and lower sidebands that are symmetric relative to the FEL frequency have opposite growth rates. There is no differentiation in the magnitude of the gain between upper and lower sidebands. The stability is determined by the sign of df sub 0/d omega sub b, the relative population of quantized oscillators with energy quantum h-bar, omega sub b where omega sub b is the synchrotron frequency in resonance with the sideband. The shear d omega sub b/dJ, where J is the action variable, is stabilizing and distributions wth gradients of df sub 0/dJ localized near the separatrix have the minimum growth rates.

22278 **(AD-A—187506/1/XAB) Research studies on extreme-ultraviolet and soft-x-ray lasers. Annual technical report, 1 September 1985-31 August 1986.** Harris, S.E.; Young, J.F. (Stanford Univ., CA (USA). Edward L. Ginzton Lab.). Aug 1987. 7p. NTIS, PC A02/MF A01.

This program investigated, both theoretically and experimentally, new approaches to constructing XUV and soft x-ray lasers; it is a continuation and extension of work sponsored by the predecessor contracts.

22279 **(AD-A—187550/9/XAB) Acousto-optic modulator as an electronically selectable unidirectional device in a ring laser.** Roy, R.; Schulz, P.A.; Walther, A. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). Sep 1987. 4p. (JA—5972). NTIS, PC A02/MF A01.

Pub. in Optics Letters, Vol. 12, No. 9, 672-674(Sep 1987).

An acousto-optic modulator causes undirectional operation of dye and Ti:sapphire ring lasers. The modulator has a low insertion loss in the cavity and can be used to switch the direction of the beam electronically. The ring laser performance is characterized, and experiments to probe the origin of the unidirectional operation are described.

22280 **(AD-A—187552/5/XAB) Prevention of current leakage in mass-transported GaInAsP/InP buried-heterostructure lasers with narrow transported regions.** Liau, A.L.; Walpole, J.N. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). Mar 1987. 9p. (JA—5880). NTIS, PC A02/MF A01.

Pub. in IEEE Jnl. of quantum Electronics, Vol. QE-23, No. 3, 313-319(Mar 1987).

The use of narrow transported regions as a simple technique to minimize current leakage was analyzed. In this model, current leakage occurs when the voltage buildup in the p-region is sufficiently large to turn on the InP homojunction in the transported region. The voltage buildup, the injected-electron concentration, the drift and diffusion of the electrons, and the resulting homojunction current have been analyzed in detail. A simple formula derived allows for device design for operation at high currents without a significant leakage.

22281 **(ENEA-RT-TIB—87-4) Operatorial disentanglement.** Dattoli, G.; Richetta, M.; Torre, A. (ENEA, Rome (Italy)). Jun 1987. 20p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751895/JAW.

We discuss a method to get the proper time ordered form of the evolution operator for Hamiltonian linear combinations of the generators of the SU(1,1), SU(2) and h(4) groups. The relevance of the obtained results to physics problems such as the generation of non-Poissonian statistics in laser plasma scattering and the analysis of pulse propagation in Free Electron Lasers is also briefly discussed.

22282 **(ENEA-RT-TIB—87-12) Analytical treatment of free electron laser in long pulse limit.** Dattoli, G.; Renieri, A.; Torre, A.; Gallardo, J.C. (ENEA, Rome (Italy)). Jul 1987. 14p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751897/JAW.

We discuss a method to obtain analytical solutions of the evolution equation of the optical signal in long pulse free electron laser oscillators in the low gain and small signal regime. Supermodes are identified with the eigenstates, harmonic oscillator orthonormal functions, of a non-hermitian Hamiltonian. Inhomogeneous broadening effects due to energy spread and emittance are included. The time-space characteristics of the laser field are obtained with a significant reduction in computer time.

22283 **(ENEA-RT-TIB—87-27) The free electron laser: a brief analysis of theory and experiment.** Dattoli, G.; Torre, A.; Doria, A.; Schettini, E. (ENEA, Rome (Italy)). Sep 1987. 27p. (CONF-8705254—1). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751900/JAW.

From 12. course on laser science and technology; Erice, Italy (11 May 1987).

This paper describes FEL physics by presenting a general overview of its history, underlying problems and promising applications.

22284 **(LA-UR—88-414) Solid hosts for dye laser rods: Part 1, Criteria for choosing a host material.** Erickson, G.F. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 5p. (CONF-871254—5). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88006478/JAW.

From Lasers '87; Lake Tahoe, NV, USA (7 Dec 1987).

This paper will attempt to provide selection criteria for polymers as hosts for flashlamp-pumped dye laser rods. The properties of transparent polymer materials are compared with typical inorganic crystal and glass hosts. 2 figs., 1 tab.

22285 **(N—88-13577) Theoretical studies of solar lasers and converters. Progress report, 15 May-31 December 1987.** Heinbockel, J. (Old Dominion Univ., Norfolk, VA (USA)). Jan 1988. 29p. (NASA-CR—181569; NAS—1.26:181569). NTIS, PC A03/MF A01.

The geometry and setup for the n-C_8F_7I iodine laser are illustrated. The mathematical modeling of this system is described. The chemical kinetics are summarized. A sensitivity analysis was performed on the parameters occurring in the differential equations describing the chemical kinetics.

22286 **(PB—88-130877/XAB) $YAlO_3$:er laser.** Weber, H.P.; Luethy, W. (Bern Univ. (Switzerland). Inst. fuer Angewandte Physik). 10 Jul 1986. 14p. (MM—1986/87-LY-1). NTIS, PC E03/MF A01.

Absorption and fluorescence properties of 1.25% and 50% $YAlO_3$:Er(3+) are summarized. Laser properties at room temperature are studied, in particular the polarization dependence. New laser lines at 1.7 microm are reported, and the laser transitions in the 3-microm range are discussed.

22287 **(PB—88-139241/XAB) Implementation of a laser with XeCl delivering 100 watts on the average.** Fontaine, B.; Forestier, B. (Institut de Mecanique des Fluides, 13 - Marseille (France)). 1986. 57p. (In French). NTIS, PC E04/MF E04.

The activity of the New Laser Group concerned mainly the following sectors: an experimental study of the laser performance of the LUX system in the gust mode; the complete model representation of the XeCl laser with avalanche discharge preionized by x rays; the model representation of the energy depot in a bundle of electrons or x rays with high energy in the active medium of an XeCl laser; study and concept of an optoelectronic device for measuring the energy distribution in the bundle of a repetitive XeCl laser; followup on the implementation of the electron or x-ray cannon with a plasma anode at high cadence in the permanent range, which is to equip the LUX system.

22288 **(PB—88-139266/XAB) Calculation of the principal transfer parameters relating to ions and electrons in helium and the helium-cadmium mixtures. Final report.** Dupouy, D. (Centre de Documentation de l'Armement (CEDOCAR), 75 - Paris (France). Direction des Recherches, Etudes et Techniques). 1986. 111p. (In French). (DRET—86/1340). NTIS, PC E06/MF E06.

While helium-cadmium lasers have been the subject of numerous studies in the recent past, the study has principally the objective of establishing the most-complete model representation possible of the cathode region of a luminescent discharge in helium-cadmium mixtures, once the principal transfer parameters in the type of mixture are determined.

22289 **(PB—88-856364/XAB) Hydrogen fluoride and deuterium fluoride lasers. January 1976-January 1988 (citations from the NTIS database). Report for January 1976-January 1988.** (National Technical Information Service, Springfield, VA (USA)). Jan 1988. 142p. NTIS PC N01/MF N01.

Supersedes PB—86-857802.

This bibliography contains citations concering the chemical reactions, molecular interactions, kinetics, and quantum mechanics in hydrogen fluoride and deuterium fluoride laser development. Studies on excitation, optical equipment, gas mixtures, and window materials for these lasers are included. The citations also cover the spectral output, power, efficiency, applications, and performance of HF and DF lasers. (This updated bibliography contains 276 citations, 22 of which are new entries to the previous edition.)

22290 **(SAND—87-1252C) Refractive index gradients in nuclear-reactor-pumped lasers: Gasdynamic effects.** Torczynski, J.R.; Gross, R.J. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 26p. (CONF-871254—3). NTIS, PC A03. Order Number DE88006099/JAW.

From Lasers '87; Lake Tahoe, NV, USA (7 Dec 1987).

In nuclear-reactor-pumped lasers, the fission-fragment energy deposition is spatially nonuniform, with less energy deposited near the laser axis than is deposited near the side walls from which the fission fragments originate. This nonuniformity causes gas to move toward the laser axis and established density and refractive index gradients perpendicular to the laser axis. In order to understand this phenomenon and describe it quantitatively, a numerical model of the gasdynamics of nuclear-reactor-pumped lasers has been developed. The numerical model simulates the two-dimensional motion of a perfect gas experiencing fission-fragment energy deposition in a rectangular or cylindrical enclosure. In addition to calculating mass density, temperature, pressure, velocity, and power density fields, ray-tracing calculations are performed to determine the beam steering caused by the varying gas density. The simulation of a representative one-dimensional rectangular case is found to be in excellent agreement with the existing analytical theory. In this case, the ray-tracing calculations indicate length limitations which result from internal focusing. Examination of cylindrical cases reveals that under certain circumstances gas motion reduces the on-axis power deposition to zero, a phenomenon termed axis-shielding. This phenomenon never occurs in rectangular cases. Simulations of experiments show good agreement between calculated and experimental Hartmann probe refractive index data. 13 refs., 17 figs.

22291 **(SAND—88-0096) Multimode-waveguide laser beam deflector.** Brannon, P.J.; Hadley, G.R.; Owyoung, A. (Sandia National Labs., Albuquerque, NM (USA)). Feb 1988. Contract AC04-76DP00789. 13p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006222/JAW.

A $LiNbO_3$ multimode-waveguide laser beam deflector using the electrooptic effect has been demonstrated. A full deflection angle of 0.23 degree is observed for 300 V applied. Propagation losses of 3 dB have been observed and full deflection times of 2 ns estimated. 15 refs., 1 fig.

22292 **(UCID—21261-Rev.1) Standard Green's function derivation of the thermal blooming compensation instability equations.** Morris, J.R. (Lawrence Livermore National Lab., CA (USA)). 14 Oct 1987. Contract W-7405-ENG-48. 14p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88006590/JAW.

An eigenvalue equation for the temporal growth rate of the thermal blooming compensation instability has been derived recently. We present a rigorous and concise derivation of all the Green's function matrix elements for the case of arbitrary axial variation of the propagation medium's flow velocity and of the thermal blooming strength. We start with the perturbation growth equation of the high-power beam in an arbitrary Galilean reference frame, include axially varying parameters at the beginning, and employ the standard scalar Green's function method for solving the high-power and beacon propagation equations. As an added benefit, we obtain the precise definition of the elements of a high-power Green's function matrix; they are the scalar Green's function and various partial de-

rivatives of it. While the high-power beam Green's function cannot be expressed in closed form (except in special cases, such as, constant velocity and blooming strength) the general Green's function solution serves as a useful rigorous basis for further approximations such as the WKB approximation. Finally, we obtain the losed loop compensation equation from the Green's functions of the three subsystems: (1) the high-power beam, (2) the low-power beacon (vacuum propagation), and (3) the compensation system.

22293 **(UCRL—15982) High power, high efficiency, 2D laser diode arrays for pumping solid state lasers.** Rosenberg, A.; McShea, J.C.; Bogdan, A.R.; Petheram, J.C.; Rosen, A. (General Electric Co., Princeton, NJ (USA). Astro-Space Div.; David Sarnoff Research Center, Princeton, NJ (USA)). Nov 1987. Contract W-7405-ENG-48. 7p. (CONF-880402—8). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004042/JAW.

From CLEO '88: OSA/IEEE conference on lasers and electro-optics; Anaheim, CA, USA (25 Apr 1988).

This document reports the current performance of 2D laser diode arrays operating at 770 nm and 808 nm for pumping promethium and neodymium solid state lasers, respectively. Typical power densities are in excess of 2kw/cm^3 with overall efficiencies greater than 30%.

22294 **(UCRL—97224) Large scale damage testing in a production environment.** Weinzapfel, C.L.; Greiner, G.J.; Walmer, C.D.; Kimmons, J.F.; Wallerstein, E.P.; Marchi, F.T.; Campbell, J.H.; Hayden, J.S.; Komiya, K.; Kitayama, T. (Lawrence Livermore National Lab., CA (USA); Schott Glass Technologies, Inc., Duryea, PA (USA); Hoya Corp., Tokyo (Japan)). Nov 1987. Contract W-7405-ENG-48. 20p. (CONF-8710165—9). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006238/JAW.

From Boulder damage symposium; Boulder, CO, USA (26 Oct 1987).

We are using laser damage test systems on a production scale to scan large castings of laser glass for the presence of damage-causing platinum inclusions. These systems support glass melting production lines at two plants; one is in the US (Schott Glass Technologies, Inc.) and the other is in Japan (Hoya Corporation). The damage test systems are designed to scan an entire glass casting using the pulsed output from a commercial Nd:YAG laser. The system is fully automated and operates unattended. Following testing, the glass casting is removed from the system and visually inspected for the presence of Pt-damage sites. We routinely test polygonally-shaped castings that are about 0.5 meter in size, weigh approximately 30 kg and contain about 7 liters of glass. It takes roughly 6 to 8 hours to test a piece of this size. To date the systems have been in use about 12 hours-per-day, up to 5 days-a-week for a period of about 15 months. Of the approximately 300 disks that have passed the damage test so far, sixty-two percent of the disks have no platinum inclusions at all and ninety-two percent have an inclusion density or less than 0.2 per liter.

22295 **(UCRL—97835) A new average-power damage test facility at LLNL.** Hildum, E.A.; Rainer, F.; Milam, D. (Lawrence Livermore National Lab., CA (USA)). Oct 1987. Contract W-7405-ENG-48. 18p. (CONF-8710165—8). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006231/JAW.

From Boulder damage symposium; Boulder, CO, USA (26 Oct 1987).

We describe a new facility for studying damage induced by 1064-nm, 16-ns, 0.6-J laser pulses at repetition rates up to 120 Hz. This facility is built around four commercial 30-Hz Nd:YAG lasers fired under computer control. The beams from the four lasers are combined using thin-film polarizers and rotating half-wave plates to obtain a single irradiated spot on a test target. We also describe computer controlled beam diagnostics based on a commercial video frame-grabber. This facility has been used to compile a database of damage thresholds for a variety of materials under average power conditions.

22296 **Fission fragment pumping of a neon plasma.** Moratz, T.J.; Kushner, M.J. (Department of Electrical and Computer Engineering, Gaseous Electronics Laboratory, University of Illinois, 607 E. Healey, Champaign, Illinois 61820). *Journal of Applied Physics;* 63: No. 5, 1796-1798(1 Mar 1988).

A method for calculating excitation and ionization rates in a plasma generated by the slowing of fission fragments in a gaseous medium (neon) is presented. The energy distribution of the fission fragments as they slow down, and the excitation and ionization of neon due to collisions with the fission fragments, are discussed. Effective W values for ionization and excitation of neon directly by the fission fragments of uranium (71.6 and 110 eV) are derived. The source function for electrons produced by direct ionization by the fission fragments is discussed and compared to that produced by an e beam. The source function of electrons produced by heavy ions has the lower average energy.

22297 **Surface evaluation of the grazing incidence mirrors for the extreme ultraviolet explorer.** Green, J.; Finley, D.S.; Bowyer, S.; Malina, R.F. (Univ. of California, Berkeley, CA). pp 228-232 of Soft x-ray optics and technology. Koch, E.E.; Schmahl, G. Bellingham, WA; Society of Photo-Optical Instrumentation Engineers (1987). (CONF-861242—).

From International conference on soft X-ray optics and technology; West Berlin, F.R. Germany (8 Dec 1986).

The Space Astrophysics Group at the University of California, Berkeley, is currently producing four grazing incidence mirrors for the Extreme Ultraviolet Explorer. In conjunction with this effort, the authors are developing improved methods for the evaluation of these mirrors' performance. Imaging and reflectivity analyses at optical and extreme ultraviolet (EUV) wavelengths allow them to quantify a mirror's performance with regard to effective area, surface roughness, and image blur. They present the results of the most recent EUV measurements, and the latest techniques for evaluating the surface microroughness.

22298 **Study of multilayers subjected to intense radiation.** Knight, L.V.; Gray, K.J.; Peterson, B.G.; Thorne, J.M.; Perkins, R.T. (Brigham Young Univ., Provo, UT). pp 410-415 of Soft x-ray optics and technology. Koch, E.E.; Schmahl, G. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-861242—).

From International conference on soft X-ray optics and technology; West Berlin, F.R. Germany (8 Dec 1986).

Many promising applications of multilayer x-ray optical elements subject them to intense radiation. In this paper the authors present simulations of multilayer performance under extreme heat loads and preliminary results of robust multilayer characterization experiments.

22299 **Progress towards demonstration of shorter wavelength soft x-ray amplifiers pumped by the nova laser.** Keane, C.; Eder, D.; London, R.; MacGowan, B.J.; Matthews, D.; Maxon, S.; Rosen, M.; Whelan, D. (Lawrence Livermore National Lab.). pp 67-68 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

Since the demonstration of lasing near 200A on the Novette laser, X-ray laser research at Lawrence Livermore National Laboratory has focused on three issues: understanding the physics of soft X-ray amplifiers, investigating the production of gain at shorter X-ray wavelengths, and demonstrating significant applications. Recently, efforts have been focussed on the second of these areas. This paper reports results of experiments and theoretical modelling whose ultimate goal is the demonstration of significant gain-length products at wavelengths below the carbon K-edge at 44A. Attainment of this objective will greatly improve prospects for biological applications of X-ray lasers. To date, two different schemes have been examined in pursuit of the goal of demonstrating gain at shorter soft X-ray wavelengths. The first is collisional excitation of Ni-like ions, which is an analog of the 3s - 3p Ne-like lasing schemes demonstrated in selenium (Z=34) through molybdenum (Z=42). Preliminary experiments have shown evidence for gain of order 1

cm/sup -1/ on several 4d-4p transitions in Ni-like europium (Z=63). The candidate lasing lines in europium range in wavelength from 101A to 66A. Line identifications, on axis/off axis spectra, and the variation of line intensities with target length support the case for gain on these transitions.

22300 **Recent results of ELF experiments at 2 mm wavelength.** Throop, A.L. (ELF Project Team, LLNL). pp 89 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

The Electron Laser Facility (ELF) is a single-pass FEL amplifier using a high-current Induction Linac (3.5 MeV. 1000 Amp), in conjunction with an electromagnetic wiggler (4.0 meter. 4 kGauss), to produce intense microwave radiation. Previous operation at 35 GHz (8.6 mm wavelength) has produced high peak powers (1 Gwatt), with high-gain (40 dB/m) and high efficiency (34%). The authors recently extended the operation of ELF to 140 GHz (2.1 mm), using a 250 Watt Extended Interaction Oscillator (E10) as a source and operating at reduced wiggler fields. After exponential growth over about 3.6 meters, the FEL signal was observed to saturate near the end of wiggler. They measured output powers, gain profiles, and overall system gain which are in good agreement with simulation codes. The results of these experiments are described.

22301 **Instabilities in laser systems at low pumping levels.** Tredicce, J.R.; Sadiky, H.; Narducci, L.M.; Bandy, D.K. (Physics Dept., Drexel Univ., Philadelphia, PA 19104). pp 36-40 of Optical chaos. Chrostowski, J.; Abraham, N.B. Bellingham, WA; Society of Photo-Optical Instrumentation Engineers (1986). (CONF-860620—).

From Society of Photo-Optical Instrumentation Engineers international symposium: topics in optical and optoelectronic applied sciences and engineering; Quebec City, Canada (2 Jun 1986).

The authors discuss a simple rate equation laser model, containing intensity-dependent parameters. Our calculations suggest that the model is consistent with the emergence of self-pulsing in the good cavity limit even at very low pump levels. The dynamical behavior of two- and four-level systems shows rather good qualitative agreement with the result of previous experimental observations.

22302 **Optical chaos.** Chrostowski, J.; Abraham, N.B. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1986). 259p. (CONF-860620—). SPIE Society of Photo-Optical Instrumentation Engineers, 1022 19 St., P.O. Box 10, Bellingham, WA 98227.

From Society of Photo-Optical Instrumentation Engineers international symposium: topics in optical and optoelectronic applied sciences and engineering; Quebec City, Canada (2 Jun 1986).

This book contains nine sections, each of which contain several papers. The section headings are: Introduction to Chaos and Instabilities, Laser Instabilities, Bistability and Chaos, Dynamics in Semiconductors, Dynamical Instabilities, Noise, and Chaos in Lasers, Four-Wave Mixing and Bistability, Nonlinear Media, Spatial Effects and Lasers with External Modulation.

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REFER ALSO TO CITATION(S) 20947, 21011, 21541, 22204, 22806

22303 **(AD-A—187095/5/XAB) Pool boiling of R-114/oil mixtures from single tubes and tube bundles. Master's thesis.** Murphy, T.J. (Naval Postgraduate School, Monterey, CA (USA)). Sep 1987. 144p. NTIS, PC A07/MF A01.

An apparatus was designed, fabricated, and operated for the testing of horizontal tube bundles for boiling of R-114 with various concentrations of oil. Preliminary data were taken on the top tube in the bundle, with and without the other tubes in operation. Results showed up to a 37% increase in the boiling heat-transfer coefficient as a result of the favorable bundle effect. In a separate single-tube apparatus, three enhanced tubes were tested at a saturation temperature of 2.2 C with oil mass concentrations of 0, 1, 2, 3, 6 and 10%. The tubes were: 1) a finned tube with 1024 fins per meter, 2) a finned tube with 1575 fins per meter and 3) a Turbo-B tube. These tubes resulted in enhancement ratios in pure refrigerant of 2.8, 3.8 and 5.2, respectively, at a practical heat flux of 30 kW/sq. meter. With 3% oil, these ratios were decreased to 2.6, 3.5 and 5, while with 10% oil, these ratios were further reduced to 2.6, 3.2 and 4.7, respectively. Based on these results, the use of Turbo-B tubes is expected to result in significant savings in weight and size of evaporators over the finned tubes presently in use on board some naval vessels.

22304 **(AD-A—187133/4/XAB) Experimental and theoretical study on cavitation inception and bubbly flow dynamics. Part 1. Design, development, and operation of a cavitation-susceptibility meter. Part 2. Linearized dynamics of bubbly and cavitating flows with bubble-dynamics effects. Doctoral thesis.** D'Agostino, L. (California Inst. of Tech., Pasadena (USA). Div. of Engineering and Applied Science). May 1987. 325p. (ENG—183-16). NTIS, PC A14/MF A01.

This theses presents the design, development and operations of a Cavitation Susceptibility Meter based on the use of a venturi tube for the measurement of the content of active cavitation nuclei in water samples. The pressure at the venturi throat is determined from the upstream pressure and the local flow velocity without corrections for viscous effects because the flow possesses a laminar potential core in all operational conditions. The detection ov cavitation and the measurement of the flow velocity are carried out optically. The apparatus comprises a Laser Doppler Velocimeter for the measurement of the flow velocity and the detection of cavitation, a custom-made electronic Signal Processor for real time generation and temporary storage of the data and a computerized system for the final acquisition and reduction of the collected data. The results of application of the Cavitation Susceptibility Meter to the measurement of the water quality of the tap water samples are presented. The results of an investigation are presented on the linearized dynamics of two-phase bubbly flows with the inclusion of bubble dynamics effects. Two flow configurations have been studied: the time dependent one-dimensional flow of a spherical bubble cloud subject to harmonic excitation of the far field external pressure and the steady state two-dimensional flow of a bubbly mixture on a slender profile of arbitrary shape.

22305 **(AD-A—187338/9/XAB) Diagnostics for research in atomization and turbulent two-phase flows. Annual report, 31 July 1986-31 July 1987.** Bachalo, W.D. (Aerometrics, Inc., Mountain View, CA (USA)). 28 Jul 1987. 17p. NTIS, PC A03/MF A01.

Innovative techniques for obtaining particle size and velocity are being investigated. The four methods are: phase-Doppler, ratiometric light-scatter detection, Lagrangian-frame particle analyzer, and scattered-light heterodyne interferometry. Although these methods have overlapping capabilities, each offers additional possibilities for providing heretofore unavailable data. The phase-Doppler method has been highly refined and provides reliable particle size and velocity measurements. However, research has been required on the light scattering mechanisms due to nonuniform-light-scattering theory and experimental observations have required the expansion of the theory to include the affects of nonuniform illumination. Under certain conditions, the detection of refracted light where none is predicted, remains as a question to be resolved. These questions apply to all of the methods addressed. However, the ratiometric techniques may be used in the on-axis forward scatter light detection mode. This will allow the measurement of irregular-shaped particles moving at high speed using light configuration, the system is limited to dilute particle fields. Currently, the theoretical analysis and optical configuration have been completed and preliminary tests have shown that the basic concept will work. Interests in turbulent dispersion of spray drops suggested the need for measuring the particle dynamics in a Lagrangian frame. The method described promises to provide tracking of individual drops and measuring their local size and velocity. Array detectors are being investigated to provide adequate speed, sensitivity, and spatial resolution. The transmitter optics have been defined.

22306 **(DFVLR-FB—87-41) Solution of two-dimensional Euler equations - experience with a finite volume code.** Kroll, N.; Jain, R.K. (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V., Koeln (Germany, F.R.)). 12 Oct 1987. 141p. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88752007/JAW.

A numerical method for the solution of two-dimensional Euler equations using a finite volume spatial discretization and Runge Kutta time stepping schemes, given by Jameson, Schmidt and Turkel, is described in detail. Critical featured of the algorithm like implementation of boundary conditions, influence of the artificial dissipation, multistage time stepping schemes, and acceleration techniques for the convergence to steady state, are analysed in detail using a modified and enhanced version of a code provided by Dornier company in 1983. Accuracy and reliability of the present computer code is tested in computing subsonic and transonic flows around various airfoils. With 53 figs., 43 refs..

22307 **(ENEA-RT-TERM—86-1) Theoretical model of direct contact condensation on horizontal surfaces.** Celata, G.P.; Farello, G.E.; Focardi, G.; Cumo, M. (ENEA, Casaccia (Italy). Centro Ricerche Energia; Rome Univ. (Italy)). (ENEA, Rome (Italy)). 1986. 28p. NTIS (US Sales Only), PC A03/MF A01. Order Number TI88701726/JAW.

In the present report, refferring to a previous experimental research a model for direct contact condensation between saturated steam (in a quasistagnant situation) and subcooled (horizontally slowly flowing) water is shown. The experiments, contrarily to the Nusselt theory, refer to a direct contact condensation situation in which a consistent and well defined bulk region takes place in the liquid phase. A good agreement appears from the comparison of predictions with the experimental data. Although the model has been developed for a particular (cylindrical) geometry, it can be easily extended to other ones. An extention to the plane geometry, together with ad hoc experiments will be accomplished in the close future. 16 refs.

22308 **(FEI—1812) Dryout in tubsunder decrease of a coolant inlet flow rate.** Boltenko, Eh.A.; Pomet'ko, R.S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1986. 15p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701566/JAW.

The equations which permit to determine the distribution of liquid between flow core and near-the-wall film under nonstationary conditions are obtained on the basis of ideas of the intensity of resulting mass exchange between flow core and near-the-wall film. To calculate local parameters a homogeneous one-dimensional equilibrium model with no respect to sliding is used. The results of calculating the time of dryout under a coolant inlet flow rate change are presented. A satisfactory agreement of calculations results with the experiment is shown.

22309 **(FEI—1836) Calculation of post-dryout heat transfer in vertical cylindrical channels.** Sergeev, V.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1987. 19p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701569/JAW.

One-dimensional technique for engineering calculation of post-dryout heat transfer in cylindrical channels of various configurations, including rod assemblies with spacing grids is suggested. The technique is based on nonequilibrium approach and enables to consider non-uniformity in thermal load distribution among heat generating surfaces and over the channel height. Comparison of the calculations according to the suggested technique with experimental data for channels of various configurations is presented. 53 refs.; 8 figs.

22310 **(INIS-BR—915) Flow distribution and stability analysis for downflow in heated channels.** Sampaio, P.A.B. de. (Associacao Brasileira de Ciencias Mecanicas, Rio de Janeiro). 1985. 4p. (In Portuguese). (CONF-8512126—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701456/JAW.

From 8. Brazilian Congress of Mechanical Engineering; Sao Jose dos Campos, Brazil (1 Dec 1985).

Flow distribution and flow stability are analysed for downflow through heated channels. It is shown that the coolant heating can cause instabilities when mass flow is reduced.

22311 **(N—88-13384) Development of an integrated BEM approach for hot fluid structure interaction. Annual report, November 1986-November 1987.** Dargush, G.F.; Banerjee, P.K.; Dunn, M.G. (Calspan Corp., Buffalo, NY (USA)). Jan 1988. 96p. (NASA-CR—181577; NAS—1.26:181577). NTIS, PC A05/MF A01.

Original document contains color illustrations.

Significant progress was made toward the goal of developing a general purpose boundary element method for hot fluid-structure interaction. For the solid phase, a boundary-only formulation was developed and implemented for uncoupled transient thermoelasticity in two dimensions. The elimination of volume discretization not only drastically reduces required modeling effort, but also permits unconstrained variation of the through-the-thickness temperature distribution. Meanwhile, for the fluids, fundamental solutions were derived for transient incompressible and compressible flow in the absence of the convective terms. Boundary element formulations were developed and described. For the incompressible case, the necessary kernal functions, under transient and steady-state conditions, were derived and fully implemented into a general purpose, multi-region boundary element code. Several examples were examined to study the suitability and convergence characteristics of the various algorithms.

22312 **(NUCLEBRAS-CDTN—548) Model of the fluid temperature field in a turbulent flow parallel to heated tube bundle.** Carvalho Tofani, P. de. (Centro de Desenvolvimento da Tecnologia Nuclear, Belo Horizonte (Brazil)). 1986. 8p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701702/JAW.

Basic understanding of thermal-hydraulic phenomena is essential to achieving reactor fuel assembly performance analysis. In this paper, a dimensionless parameter - a normalized fluid temperature - is defined and applied to fluid temperature measurements at particular positions at the exit plane of a bank of nine heated tubes, under different transverse heat flux shapes. This parameter presents an asymptotic trend to equilibrium values, which depend upon considered positions and flux shapes, when increasing the bulk Reynolds Number. Proposed correlations underlie the present approach to predict the fluid temperature field within the tube bundle.

22313 **(NUCLEBRAS-CDTN—550) Evaluation method of the fluid enthalpy factors accordingly the rod bundle subchannels.** Carvalho Tofani, P. de. (Centro de Desenvolvimento da Tecnologia Nuclear, Belo Horizonte (Brazil)). 1986. 8p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701703/JAW.

Usual thermal-hydraulic subchannel analysis of nuclear fuel assemblies, allows determining fluid enthalpy factors and, accordingly, the hot subchannel factor. In this paper, a method for enthalpy factors calculation, based upon a dimensionless parameter - a normalized fluid enthalpy - is proposed. This parameter when computed with available subchannel exit enthalpy data, obtained from experiments carried out with a nine heated tube bundle, shows an asymptotic trend to equilibrium values, function of the subchannel types and transverse tube wall heat flux tilts, when increasing the coolant flow. Developed correlations allow evaluating bundle subchannel enthalpy factors. (Autor).

22314 **(NUCLEBRAS-CDTN—554) Relation between medium fluid temperature and centroid subchannel temperatures of a nuclear fuel bundle mock-up.** Carvalho Tofani, P. de. (Centro de Desenvolvimento da Tecnologia Nuclear, Belo Horizonte (Brazil)). 1986. 8p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701704/JAW.

The subchannel method used in nuclear fuel bundle thermal-hydraulic analysis lies in the statement that subchannel fluid temperatures are taken at mixed mean values. However, the develop-

ment of mixing correlations and code assessment procedures are, sometimes in the literature, based upon the assumption of identity between lumped and local (subchannel centroid) temperature values. The present paper is concerned with the presentation of an approach for correlating lumped to centroid subchannel temperatures, based upon previously formulated models by the author, applied, applied to a nine heated tube bundle experimental data set.

22315 **(SAND—87-7159) An experimental investigation of decelerating flow about two-dimensional cambered plates.** Sarpkaya, T. (Naval Postgraduate School, Monterey, CA (USA). Dept. of Mechanical Engineering). 30 Oct 1987. Contract AC04-76DP00789. 54p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88006598/JAW.

Impulsively-started uniform flow, decelerating at specified rates, about two-dimensional cambered plates with included angles of 120, 180, and 240 degrees has been investigated experimentally in a vertical water tunnel. The forces acting on the plates have been determined as a function of the relative displacement of the fluid at subcritical Reynolds numbers. The evolution of the vortices was visualized by means of various dyes and polystyrene beads. The variation of the drag coefficient with time is interpreted in terms of the formation, growth, and motion of vortices. 15 figs.

22316 **(SAND—87-7160) Discrete vortex analysis of unsteady flow about two-dimensional cambered plates.** Sarpkaya, T. (Hydrodynamics Applications, Inc., Carmel, CA (USA)). 30 Oct 1987. Contract AC04-76DP00789. 129p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88006597/JAW.

The evolution of a two-dimensional, incompressible, rapidly decelerating, time-dependent viscous flow about three cambered plates with included angles of 120, 180, and 240 degrees is simulated through the use of the discrete vortex model. Vorticity is represented by a distribution of discrete vortices. Each vortex is convected in the velocity field, calculated locally using the Biot-Savart law. The roll-up of the vortex sheets, the distribution of velocity and pressure on the cambers, and the drag force are calculated at suitable time intervals for a prescribed time-dependent flow. The results are compared with those obtained experimentally. 59 figs.

22317 **(SAND—88-7011) Velocity and concentration measurements in flowing suspensions by nuclear magnetic resonance.** Majors, P.D.; Altobelli, S.A.; Fukushima, Eiichi; Givler, R.C. (Lovelace Medical Foundation, Albuquerque, NM (USA). Research Div.; Sandia National Labs., Albuquerque, NM (USA)). Jan 1988. Contract AC04-76DP00789. 28p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006225/JAW.

Noninvasive measurements are performed on fluid-particle flows with nuclear magnetic resonance techniques. These techniques are used to determine the characteristics of suspensions flowing axially in a cylindrical tube. The nonuniform velocity and concentration profiles, which result from the flow of a suspension of heavy particles, are presented. 37 refs., 9 figs.

22318 **Structure and dynamics of reacting plane mixing layers.** Keller, J.O.; Ellzey, J.L.; Pitz, R.W.; Shepherd, I.G.; Daily, J.W. (Sandia National Labs., Livermore, CA, USA; Wisconsin Univ., Madison, USA; Vanderbilt Univ., Nashville, TN, USA; California Univ., Berkeley, USA). *Experiments in Fluids;* **6**: No. 1, 33-43(1988).

The reacting two-dimensional plane mixing layer has been studied in two configurations: a rearward facing step and a two-stream mixing layer. Observations have been made of the steady state behavior, and the unsteady behavior when the flow was forced by a specific acoustic frequency. The steady behavior of the mean properties of the reacting flows is similar to that of non-reacting free shear flows except for the global effects of thermodynamic property changes. The structure of these flows is qualitatively similar to that of non-reacting flows. Vortices form by the two-dimensional Kelvin-Helmholtz instability and grow by subharmonic combination until the mixing layer interacts with the walls. Entrainment is dominated by the two-dimensional vortex motion. Three-dimensional instabilities give rise to secondary vortices which are coherent over several Kelvin-Helmholtz structures and dominate the fine scale mixing process. The mixing transition corresponds to a loss of coherence in the layer. Unsteady behavior occurs when there are resonant interactions with the Kelvin-Helmholtz instability or the instability associated with the recirculation vortex in the reward facing step flow. Modeling efforts are reported which show promise of simulating the essential features of plane mixing layers.

22319 **General behavior of dilute binary solutions.** Cochran, H.D.; Lee, L.L. (Chemical Technology Div., Oak Ridge National Lab., Oak Ridge, TN 37831). *A.I.Ch.E. Journal (New York);* **33**: No. 8, 1391-1393(Aug 1987). Contract AC05-84OR21400.

The authors presented general thermodynamic expressions for the behavior of fugacity coefficients and activity coefficients in dilute solutions by expansion about the infinite dilution limit. They showed that their thermodynamic formalism accurately represented the behavior of dilute solutions of a nonvolatile solid solute in a supercritical solvent. A somewhat similar approach has been taken in developing a model for dilute solutions of a non-volatile solid solute in a supercritical solvent. These authors based their approach on the general statistical mechanical theory of solutions. In this paper the authors present the basis for modeling using molecular theories of mixtures within the formalism of fluctuation theory.

22320 **The role of porosity in filtration. Part XI: Filtration followed by expression.** Tiller, F.M.; Yeh, C.S. (Dept. of Chemical Engineering, Univ. of Houston, Houston, TX 77004). *A.I.Ch.E. Journal (New York);* **33**: No. 8, 1241-1256(Aug 1987).

This paper addresses the question of the relative amounts of liquid removed during filtration and expression as a function of cake compressibility. As liquid flows through a porous cake, the accumulative drag collapses the particulate structure, thereby increasing the solid content and displacing the liquid. The use of pump pressure in filtration represents the simplest hydraulic deliquoring process. In expression operations, pistons, membranes, rollers, or belts are employed to squeeze the particulate cake after filtration is complete. Filtration followed by expression at constant pressures ranging from 0.6 to 24.7 MPa (6.1-243.6 atm) was investigated theoretically and experimentally. During filtration and the early stages of expression, the flow rate and average liquid content of highly compressible attapulgite were virtually unaffected by increasing pressure in the range investigated.

22321 **Snap-off of gas bubbles in smoothly constricted noncircular capillaries.** Ransohoff, T.C.; Gauglitz, P.A.; Radke, C.J. (Dept. of Chemical Engineering, Univ. of California, Berkeley, Berkeley, CA 94720). *A.I.Ch.E. Journal (New York);* **33**: No. 5, 753-765(May 1987).

A corner flow hydrodynamic theory is outlined for the time to snap-off of a gas bubble moving through a smoothly constricted noncircular capillary as a function of the pore geometry and the capillary number, Ca. Above a transition capillary number the time to snap-off is independent of Ca, while below it the time to snap-off is inversely proportional to the capillary number. Thin films of liquid deposited along the capillary walls are shown to play a minor role; they are accordingly neglected in the analysis. The proposed theory is compared to new experimental results for snap-off in two constricted square capillaries (dimensionless constriction radii of 0.3 and 0.5) over a range of capillary numbers (10/sup -5/ to 10/sup -3/), wetting-liquid viscosities (1.0 to 8.5 mPa . s), and surfactant types. Good agreement is found between theory and experiment.

22322 **Modeling heat and mass transfer in catalytic wood gasification.** Brown, M.D.; Robertus, R.J.; Mudge, L.K.; Baker, E.G. (Pacific Northwest Lab., Richland, WA 99352). pp 431-434 of Applied simulation and modeling. Koval, D.O. Anaheim, CA; Acta Press (1986). (CONF-8606112—).

From IASTED modelling and simulation conference; Vancouver, Canada (4 Jun 1986).

Current research in the gasification of biomass materials includes production of a methanol synthesis gas catalytically. Previous experiments have indicated early deactivation of catalysts due primarily to carbon deposition. This study presents the results of ef-

forts to model the heat and mass transfer within a spherical catalyst pellet using orthogonal collocation. Solutions are presented which predict temperature and concentration distributions and pellet effectiveness factors. These solutions are compared to a thermodynamic equilibrium model to predict regimes of carbon deposition and subsequent deactivation. Experimental data are presented which support conclusions drawn above.

4205 Materials Testing

REFER ALSO TO CITATION(S) 21958, 22046, 22047

22323 **(ENEA-RT-TERM—86-8) Diagnostics of erosive phenomena in the blades of a turbine. Possible uses of the thin layer activation technique.** De Massimi, A.; Imperiali, F.; Frazzoli, F.V. (ENEA, Casaccia (Italy). Centro Ricerche Energia; Rome Univ. (Italy)). (ENEA, Rome (Italy)). 1986. 117p. (In Italian). NTIS (US Sales Only), PC A06/MF A01. Order Number TI88701727/JAW.

The factors examined are those considered to be of interest with regard to the possibility applying the technique of thin layer activation for the survey and on-line monitoring of erosive phenomena in the blades of a power turbine. The technique is described with its characteristics, the typical fields in which it is used and its developments; in particular, the main parameters that characterize it and the connections that exist between these and the kind of applications to be carried out are shown. The general characteristics of the turbine are presented; the study is aimed mainly at gathering the special data necessary to apply the technique. In particular, to verify the applicability of the method of analysis in turbines, the following objectives are considered: 1) Identification of suitable radioisotopes and of their level of activity; 2) Dimensioning of the area to activate and its location on the blades; 3) Necessary instrumentation; 4) Protectionist problems. 48 refs.

22324 **(FEI—1781) Computerized system for radiation creep study of materials in the BR-10 reactor. Multichannel temperature meter.** Vyrodov, P.V.; Kruglov, A.S.; Fazkullin, V.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1986. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701010/JAW.

A device for long-term computerized measurement and recording of temperature is described. The device is equipped with means for self-testing the measuring system and for computerized correction of graduation nonlinearity of chromel-alumel thermocouples in the 0-900 deg C range. The device services approximately 100 thermocouples and it may be used as the ASNI subsystem or an autonomous temperature meter. 3 figs.

22325 **(PB—88-856935/XAB) Nondestructive testing: x-ray radiography techniques. January 1973-January 1988 (citations from Information Services in Mechanical Engineering database). Report for January 1973-January 1988.** (National Technical Information Service, Springfield, VA (USA)). Jan 1988. 132p. NTIS PC N01/MF N01.

Supersedes PB—87-851796.

This bibliography contains citations concerning x-ray radiographic techniques, equipment, and instruments for the nondestructive examination and testing of materials, objects, and structures. Nondestructive assay methods and equipment are included. Considerable attention is given to nondestructive stress measurement and analysis, and the detection of flaws or structural defects. (This updated bibliography contains 340 citations, 61 of which are new entries to the previous edition.)

22326 **(RISO-M—2654) Recording radiographic images on nitrocellulose film in neutron.** Domanus, J.C. (Risoe National Lab., Roskilde (Denmark)). Aug 1987. 19p. (CONF-8709161—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88752050/JAW.

From 4. European conference on non-destructive testing; London, UK (13 Sep 1987).

Nitrocellulose film, insensitive to X- and gamma-rays (as well as visible light), is especially suitable for neutron radiography of spent nuclear reactor fuel, which itself is a source of high-intensi gamma-radiation. As nitrocellulose film is also insensitive to neutrons a converter is necessary to convert neutrons to alpha particles, which in turn are able to produce a radiographic image on the film. This image, in the form of minute pits in the film, must thereafter be made visible by etching the nitrocellulose film to thereby enlarge the pits so much as to produce a visible image on th film. After a short description of neutron radiography facilities at various reactor types three methods of producing neutron radiographs are explained (direct, transfer and track-etch). Nitrocellulose film and neutron-to-alpha converters used with it are described. Radiographic image quality of this film is compared with that of silver halide film. A similar comparison is made of the accuracy of dimensional measurements from neutron radiographs.

22327 **(UCRL—98170) Physics of condensed matter at extreme conditions.** Ross, M. (Lawrence Livermore National Lab., CA (USA)). 5 Feb 1988. Contract W-7405-ENG-48. 9p. (CONF-880110—20). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88006232/JAW.

From SPIE O-E Lase '88: optoelectronics and laser applications in science and engineering; Los Angeles, CA, USA (10 Jan 1988).

The study of matter under extreme conditions is a highly interdisciplinary subject with broad applications to materials science, geophysics and astrophysics. High-pressure properties are studied in the laboratory using static and dynamic techniques. The two differ drastically in the methods of generating and measuring pressure and in the fundamentally different nature of the final compressed state. This article covers a very broad range of conditions, intended to present an overview of important recent developments and to emphasize the behavior of materials and the kinds of properties now being studied.

22328 **Automated system for relative sound velocity and ultrasonic attenuation measurements.** Toulouse, J.; Launay, C. (Lehigh University, Bethlehem, Pennsylvania 18015). *Review of Scientific Instruments;* **59**: No. 3, 492-495(Mar 1988).

In order to facilitate measurements of ultrasonic velocity and attenuation, we have developed an automated version of the phase sensitive technique with quadrature detection. The technique is outlined and the precision of relative transit time or velocity measurements that can be obtained from it is analyzed. We describe the computer-controlled experimental setup and report relative velocity and attenuation results obtained on a single crystal of pure $KZnF_3$. The temperature dependence of the elastic constants C/sub 11/ and C/sub 44/ calculated from these results agree very well with that obtained from echo overlap measurements performed on the same crystal. The relative error on the present velocity measurements is $\Delta v/v \sim 10/sup -5/$.

4208 Electronic Circuits And Devices

REFER ALSO TO CITATION(S) 21236, 21655, 22087, 22123, 22279, 22527, 23788

22329 **(AD-A—186816/5/XAB) Report on the effects of neutron irradiation of GaAs semiconductors. Master's thesis.** Callahan, J.K. (Naval Postgraduate School, Monterey, CA (USA)). Jun 1987. 43p. NTIS, PC A03/MF A01.

The effects of neutron irradiation in GaAs MMICs and small-signal FETs were investigated. Carrier concentration and mobility were measured as a function of fluence, doping, and channel depth. The individual components of the MMICs were also measured. Device degradation was determined to be the result of a combination of decreases in carrier concentration and mobility in the FETs. Radiation hardness levels based on 20% degradation in gain and drain current were determined.

22330 **(AD-A—186936/1/XAB) Basic mechanisms of radiation effects in electronic materials and devices. Final report, September 1986-September 1987.** McLean, F.B.; Oldham, T.R. (Harry Diamond Labs., Adelphi, MD (USA)). Sep 1987. 92p. (HDL-TR—2129). NTIS, PC A05/MF A01.

This report reviews the primary physical processes underlying the response of electronic materials and devices to radiation as well as the relationship of these processes to the modes of circuit degradation and failure. An overview presents brief discussions of the major radiation environments of practical interest, the interaction of radiation with solid targets, common terminology of radiation exposure, and the primary radiation effects in electronic materials, including ionization effects (radiation-induced photocurrents and space charge buildup) and atomic displacement damage effects. An emphasis is given to the problem of total-dose ionization response, primarily in metal-oxide-semiconductor (MOS) systems. In particular, a description of the basic physical phenomena underlying the complex time history of the MOS radiation response is given, and some implications of the time-dependent response for issues of radiation testing, hardness assurance, and radiation-response prediction are pointed out. There is also discussion on the implications of scaling down the gate oxide thickness and on the increasingly important problem of radiation-induced leakage currents.

22331 **(AD-A—187346/2/XAB) Electronic structure of InAs/GaSb (001) superlattices - two-dimensional effects.** Madhukar, A.; Nucho, R.N. (University of Southern California, Los Angeles (USA). Dept. of Physics). 1979. 6p. NTIS, PC A02/MF A01.

Pub. in Solid State Communications, Vol. 32, No. 4, 331-336(1979).

Detailed calculations of the two-dimensional effects in the electronic structure of Indium Arsenic Gallium Antimony (001) superlattices are presented for the first time. Comparison of the calculated thickness dependence of the superlattice band gap with optical-absorption measurements shows that, at the Gamma-point, the conduction band edge of InAs lies about 60 meV below the valence band edge of GaSb. Eigenfunctions of the highest light and heavy hole bands, and the lowest two conduction bands exhibit spatially confined nature in the GaSb and InAs regions, respectively, thus establishing the two-dimensional nature of these bands. The calculated conduction band effective mass in the plane of the superlattice near the gamma-point is found to be enhanced by a factor of 2.5 over the bulk InAs value and compares very well with the appropriate mass extracted from recent magnetoresistance measurements.

22332 **(AD-A—187416/3/XAB) MBE (molecular beam epitaxial) growth characterization and electronic-device processing of HgCdTe, HgZnTe, related heterojunctions and HgCdTe-CdTe superlattices: quarterly report, June 15, 1987.** Faurie, J.P. (Chicago Univ., IL (USA). Dept. of Physics). 15 Jun 1987. 24p. NTIS, PC A03/MF A01.

As the MBE growth technique has continued to improve for Hg(1-x)Cd(x)Te films, the prospects for films of larger area have begun to be explored. These larger area films are important for imaging arrays and will be especially vital in the future for the efficient production of Hg(1-x)Cd(x)Te material. The growth of MBE of uniform Hg(1-x)Cd(x)Te epilayer on a large substrate is very difficult to achieve because of the non-uniform distribution of the fluxes and on the non-uniform temperature of the substrate.

22333 **(AD-A—187417/1/XAB) Optically controlled devices and ultrafast laser sources for signal processing. Final report, 1 July 1984-30 June 1987.** Lee, C.H.; Ho, P.T. (Maryland Univ., College Park (USA). Dept. of Electrical Engineering). 30 Jun 1987. 108p. NTIS, PC A06/MF A01.

Progress to date is summarized as follows: 1. Experimental confirmation was made of the pulse-formation mechanism in a laser modelocked by a slow saturable absorber as proposed by New and Haus. 2. It is shown analytically and experimentally that the degree of coherence is the same in a diode laser whether modelocked or singlemode at the same power. 3. The continuously operating phosphate Nd:glass laser was modelocked for the first time ever to generate 7-ps pulses. The authors also successfully amplified these pulses to J/pulse at 500 Hz rate.

22334 **(AD-A—187456/9/XAB) MBE (molecular beam epitaxial) growth, characterization, and electronic-device processing of HgCdTe, HgZnTe, related heterojunctions, and HgCdTe-CdTe superlattices. Quarterly report, March 15, 1987.** Faurie, J.P. (Illinois Univ., Chicago (USA). Dept. of Physics). 15 Mar 1987. 23p. NTIS, PC A03/MF A01.

Results were obtained for MBE-grown N & P-type layers in terms of carrier concentration and electron or hole mobilities; most layers were grown after the start date of the current contract. It is important to point out that even if these results are the best ever obtained in the laboratory, they are representative of the authors level of control concerning the growth. Numerous layers with the same composition exhibit very similar results. A new Hg cell, which is a prototype built by ISA - Riber, is currently being tested. This cell gives a very stable Hg flux during hours of growth. It should be noted that both mobility and carrier concentration values are suitable for IR device application.

22335 **(AD-A—187554/1/XAB) Local stoichiometry and atomic interdiffusion during reactive metal/mercury-cadmium-telluride junction formation. Interim report.** Wall, A.; Raisanen, A.; Chang, S.; Philip, P.; Troullier, N. (Minnesota Univ., Minneapolis (USA). Dept. of Chemical Engineering and Materials Science). 23 Oct 1987. 19p. (TR—12). NTIS, PC A03/MF A01.

Synchrotron-radiation photoemission studies of Ag, Ge, and Sm overlayers on Hg1-xCdxTe (110) surfaces are summarized. These metals exhibit widely different interface reactivity with Hg/sub 1-x/Cd/sub x/Te and yield a range of different interface morphologies. To assess the relative importance of the microscopic driving forces that determine the local composition at the interface and in the semiconductor near-surface region, the authors present a systematic comparison the data with calculated thermodynamic parameters such as the cation-metal heat of solution, the heat of alloying from Miedema's semi-empirical model, and the metal/telluride formation enthalpy.

22336 **(PB—88-156716/XAB) Silicon-on-insulator: a categorized bibliography including abstracts. Special pub.** Baghdadi, A.; Walters, E.J. (National Engineering Lab. (NBS), Washington, DC (USA)). Dec 1987. 215p. (NBS/SP—400/80). NTIS, PC A10/MF A01.

Also available from Supt. of Docs. as SN003-003-02839-8; Library of Congress catalog card No. 87-619901.

This bibliography of silicon-on-insulator SOI technology was compiled from a literature search of three data bases: INSPEC, Engineering Index, and Chemical Abstracts. The bibliography is categorized according to the technique used to produce the SOI substrate. It includes the abstracts for most of the papers. It can either be used to obtain a quick evaluation of the state of the art in a particular SOI technique, or as a guide for further in-depth study.

22337 **(SAND—87-2194) Scale-up of a batch-type chemical powder preparation process for high field varistor fabrication.** Gardner, T.J.; Lockwood, S.J. (Sandia National Labs., Albuquerque, NM (USA)). Feb 1988. Contract AC04-76DP00789. 128p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88006601/JAW.

A batch-type chemical preparation process for the fabrication of high field varistor powders was scaled-up from a laboratory scale to a batch size (1 kg) deemed suitable for technology transfer to an appropriate manufacturing agency. Process development activities concerning batch preparation and reproducibility, impurity effects on varistor properties, electrical property degradation, and other scale-up problems were investigated. Detailed descriptions of the specific problems encountered and the resulting solutions are documented. A summary of the 1 kg inter-batch reproducibility with respect to both powder characteristics and sintered varistor properties is presented. In-depth process documentation is supplied in the appendices of this report. 40 refs., 15 figs., 12 tabs.

22338 **(UCID—21322) FIRESET.** Lee, R.S. (Lawrence Livermore National Lab., CA (USA)). 19 Feb 1988. Contract W-7405-ENG-48. 17p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006721/JAW.

FIRESET is a PC-based computer code which calculates current as a function of time for an RLC circuit containing up to fifteen series conductors which undergo rapid heating and subsequent explosion as a consequence of an electric current which passes through them. In its original form, the code was developed to model electrical waveforms measured when a large, typically 25.4 x 25.4 x 0.051-mm, aluminum foil was exploded using a capacitor bank with tens of kilojoules of stored energy. The code proved to be useful for this purpose, and it was recognized that it could also be used for modeling the electrical response of detonator bridgewires. In view of the increasing use of slapper detonators for DOD applications, we wish to make the latest version of the code, available to DOD laboratories and contractors for use in designing firing systems which employ slapper or exploding bridgewire detonators. This document provides instructions for the code.

22339 **Fluid simulations of current conduction in the plasma erosion opening switch.** Grossmann, J.M.; Mosher, D.; Ottinger, P.F. (Naval Research Lab., Washington, DC 20375). pp 50 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

Experimental observations of the PEOS indicate that during its conduction phase (while the switch isolates the load), the magnetic field and current penetrate the plasma in a broad channel. In some cases, a large fraction of the original plasma volume carries current radially across the anode cathode gap. The magnetic field penetrates much more deeply into the plasma than the electromagnetic skin depth, implying that electrode effects are important. PIC simulations of low density (eta < 4x10/sup 12/ cm/sup -3/) PEOS operation also show magnetic field and current penetration deep into the plasma, although the current channels are much narrower than observed experimentally unless the emitted electrons experience scattering or energy loss due to anomalous resistivity. In order to examine these issues, and to augment a purely analytical fluid investigation of current conduction in the PEOS/sup 2/, a 1-1/2 D electromagnetic two fluid code has been developed. In this fluid code, it is assumed that cathode electron emission is space charge limited and that this restraint on the current density controls the unusual penetration of current into the plasma. This aspect of the switch's behavior is inherently 2 D and must be artificially modeled in a 1 D treatment. The fluid technique allows the simulation of switches in parameter regimes (eta > 10/sup 13/ cm/sup -3/ and current risetimes > 40 etas) that correspond to many experiments, but that are difficult to model with PIC codes. Results have confirmed many features of the analytic fluid model and support key observations of the PIC simulations. Current is carried radially by E x B drift of electrons and field structures follow the analytic model. Test electrons emitted from the cathode are conducted across the switch in broader channels when they are scattered or their energies are reduced by collisional processes near the cathode. Results of this analysis are presented.

22340 **Particle simulations of electron flow during the opening phase of a PEOS.** Lawconnell, R.I.; Grossmann, J.M.; Neri, J.M.; Ottinger, P.F. (Naval Research Lab., Washington, DC 20375). pp 50-51 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

The plasma erosion opening switch (PEOS) has been used as a fast output switch on pulsed power generators. It can conduct MA levels of current for 10's of ns before switching the current to a load in less than 10 ns. The PEOS can be used on TW level systems for inductive storage, pulse compression, rise time sharpening, and power multiplication by pulse compression. In cylindrical geometries the switch typically conducts current through a plasma injected through a screen in the outer anode onto a central cathode. When the ion current through the switch exceeds the ion flow supplied by the injected plasma fill, the switch begins to open. As it begins to open, there is initially a significant impedance mismatch between the plasma region and the downstream power feed and load. This mismatch causes electrons to stream across the cathode-anode gap making them unavailable to power the load. As the plasma erosion proceeds the impedance mismatch decreases and magnetic insulation of the electrons begins to be significant. In the PEOS, the plasma erosion and the magnetic insulation of the electron often occurs in a few ns, so that there is little power loss across the switch during opening.

22341 **Simulated dynamics of plasma erosion opening switches.** Mason, R.J. (Los Alamos National Lab., Los Alamos, NM 87545). pp 51 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

Inductive storage devices can be smaller, lighter, and more economical than corresponding capacitive units. With inductive storage a current must flow in a low impedance circuit, until it is redirected by the opening of a switch and transferred to a load. Experimentally, the Plasma Erosion Opening Switch (PEOS) has successfully supported megaampere level current for 50-500 ns periods before opening in as little s 10 or 5 ns. The 2-D code ANTHEM has been used to simulate this opening switch phenomonology. The electric and magnetic fields are determined by the Implicit Moment Method. Thus, ω/sub rho/Δt>>1 and Δx/λ/sub D/>>1 are permitted in the calculations. The ions are treated as a fluid. Electrons are modeled as either one (or two) fluids with inertia, or as collisional PIC particles. Charge separation effects are retained, but no special difficulties are imposed by the presence of very dense regions in the plasma filling the switch. Results are presented from studies spanning the operating characteristic of NRL;s gamble I to Sandia's PBFA II switches: (a) Operating densities from 10/sup 11/ cm/sup -3/ to 10/sup 14/ cm/sup -3/ (b) Channel widths ranging from 2.5 to 8 cm, (c) Peak driving magnetic fields from 0.8 to 2.5 Tesla. Discussion addresses the influence of fill-plasma flow velocity and direction, sheath effects with space-charge limited emission and magnetic insulation, relativistic influences, anamolous resistivity, fill-density and its homogenity, as well as the possible operational benefits from additional preset and/or driven external magnetic fields.

22342 **Theoretical analysis of PEOS experiments.** Ottinger, P.F.; Commisso, R.J.; Grossmann, J.M.; Hinshelwood, D.D.; Mosher, D.; Neri, J.M.; Weber, B.V. (Naval Research Lab., Washington, DC 20375). pp 78-79 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

The plasma erosion opening switch (PEOS) is a fast opening vacuum switch which has been used in various pulsed power experiments to provide pulse compression and voltage multiplication. A model for the switch has been developed. In this model, the PEOS conducts current without opening until a current level is reached. This current level is determined by the plasma parameters and the experimental geometry. Once this current level is exceeded, erosion of the PEOS plasma begins and the electron flow in the switch region eventually becomes magnetically insulated in the resulting gap. The switch is then open. This theoretical picture of PEOS operation has been incorporated into a transmission line code for comparison with experiment. Here, the model will be used to analyze four sets of experiments: 1) radius scaling experiments on Gamble II at NRL and Blackjack 5 at Maxwell Laboratories, 2) experiments using the Sandia PBFA II hardware on Blackjack 5, 3) PEOS experiments on PBFA II at Sandia National Laboratories, and 4) IBOS experiments at Cornell University. Results will be discussed comparing values of PEOS parameters expected in the experiment with values of the model parameters found to provide a good fit to the measured current and voltage waveforms.

4209 Waste Processing Plants And Equipment

22343 (DOE/CH/10093—6, pp 98) **Update mechanical status report.** Mayberry, J.L. (EG & G Idaho, Inc., Idaho Falls). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW. Contract AC07-76ID01570.

In Biofuels and municipal waste technology research program summary: FY 1986.

The objective of this task is to update the EG & G Energy from Municipal Solid Waste Mechanical Equipment and Systems Status Report. The first task will be to develop a current list of RDF plants (large and small) from the literature, DOE sources, and personal contacts; to establish the current status of operation (operating, shutdown, intermittent); and to develop an initial equipment configuration and basic operating data on each plant. A follow-on activity will include visits to selected RDF facilities to evaluate their current status, problems, equipment flow, configuration, equipment vendors and models, and the effectiveness of the equipment being used. An analysis of the plant visits will be done.

22344 (DOE/CH/10093—6, pp 99) **Proof of concept vibrating mesh screen.** Mayberry, J.L. (EG & G Idaho, Inc., Idaho Falls). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

EG & G, over the past year, has been working with manufacturers of agricultural conveyors to adapt their equipment to RDF separation. The task objective is to build and test a prototype one-half width vibrating mesh screen conveyor (VMSC) to determine the operation efficiency. The first task will be to determine the feasibility (technical and economical) of extending the VMSC from 10 ft long to 20 ft long and the ability to change elevation; to establish the particle size distribution for a single shred from a shear shredder and horizontal hammermill; and to develop a bid package with specifications and concept drawings. After the feasibility task is complete, a subcontract will be bid and awarded for the fabrication of the VMSC and the field test of the prototype unit. Following the awarding of the contract(s), a test of the VMSC under a continuous load of coarse RDF under various operating conditions will be run.

22345 (DOE/CH/10093—6, pp 100) **Evaluation of disc screens.** Mayberry, J.L. (EG & G Idaho, Inc., Idaho Falls). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW. Contract AC07-76ID01570.

In Biofuels and municipal waste technology research program summary: FY 1986.

The proposed disc screen test evaluation program will determine the performance characteristics of the disc screen, particularly the efficiency of separation in refuse derived fuel production, and then compare them to those of the trommel. The first task will be to conduct a meeting of personnel from EG & G Idaho and Cal Recovery Systems in order to coordinate the research efforts of the two companies, to develop a test plan for both research efforts to use, and to develop a list of manufacturers and facilities with disc screens. Next, a test evaluation program will be conducted in as many facilities for which there is funding and give the widest range of independent variables. After the testing program is completed, the data will be analyzed and summarized into a database. Then the data from disc screens will be compared with data from trommels.

4210 Combustion Systems

REFER ALSO TO CITATION(S) 20786, 22691

22346 **(AD-A—187419/7/XAB) Boiler stack-gas heat recovery. Final report, October 1984-September 1986.** Lu, P.C.; Fu, T.T.; Garg, S.C.; Nowakowski, G. (Naval Civil Engineering Lab., Port Hueneme, CA (USA)). Sep 1987. 97p. (NCEL-TN-N—1776). NTIS, PC A05/MF A01.

This report is a detailed study of various heat-recovery schemes for Navy shore facilities to use otherwise lost stack heat. The waste heat can be used alternatively to improve the boiler efficiency through feedwater and/or combustion-air preheating, or to lighten the boiler load through process-steam/water heating. The procedure for estimating the energy potential of a given flue-gas stream is explained in detail with sample plots. Based upon economic analysis for available options, three cost-effective methods of recovering waste heat were identified; the conventional economizer, the direct-contact heat exchanger, and the indirect-contact condensing heat exchanger with temperature-raising by heat pumps, if appropriate. Important items such as materials, corrosion, maintenance, control, and retrofit are discussed. It is recommended that the entire process of selection and planning be incorporated in Computer Aided Engineering (CAE) software, and the conclusions be verified by testing in an actual retrofit unit.

22347 **(N—88-13745) Thermal finite-element analysis of space shuttle main engine turbine blade.** Abdul-Aziz, A.; Tong, M.T.; Kaufman, A. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Oct 1987. 11p. (NASA-TM—100117; E—3535; NAS—1.15:100117). NTIS, PC A03/MF A01.

Finite-element, transient heat transfer analyses were performed for the first-stage blades of the space shuttle main engine (SSME) high-pressure fuel turbopump. The analyses were based on test engine data provided by Rocketdyne. Heat transfer coefficients were predicted by performing a boundary-layer analysis at steady-state conditions with the STAN5 boundary-layer code. Two different peak-temperature overshoots were evaluated for the startup transient. Cutoff transient conditions were also analyzed. A reduced gas temperature profile based on actual thermocouple data was also considered. Transient heat transfer analyses were conducted with the MARC finite-element computer code.

22348 **(N—88-14320) HOST turbine heat transfer program summary.** Gladden, H.J.; Simoneau, R.J. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1988. 22p. (NASA-TM—100280; E—3876; NAS—1.15:100280; CONF-880607—). NTIS, PC A03/MF A01.

From 33. international gas turbine conference and exhibit; Amsterdam, Netherlands (5 Jun 1988).

The objectives of the HOST Turbine Heat Transfer subproject were to obtain a better understanding of the physics of the aerothermodynamic phenomena and to assess and improve the analytical methods used to predict the flow and heat transfer in high temperature gas turbines. At the time the HOST project was initiated, an across-the-board improvement in turbine design technology was needed. A building-block approach was utilized and the research ranged from the study of fundamental phenomena and modeling to experiments in simulated real engine environments. Experimental research accounted for approximately 75 percent of the funding with the remainder going to analytical efforts. A healthy government/industry/university partnership, with industry providing almost half of the research, was created to advance the turbine heat transfer design technology base.

22349 **(N—88-14339) Recent advances in high temperature instrumentation for hot section applications.** Englund, D.R.; Seasholtz, R.G. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1988. 25p. (NASA-TM—100282; E—3923; NAS—1.15:100282; CONF-880607—). NTIS, PC A03/MF A01.

From 33. international gas turbine conference and exhibit; Amsterdam, Netherlands (5 Jun 1988).

Programs to develop research instrumentation for use in turbine engine hot sections are described. These programs were initiated to provide improved measurements capability as support for a multidisciplinary effort to establish technolgy leading to improved hot section durability. Specific measurement systems described here include heat flux sensors, a dynamic gas temperature measuring system, laser anemometry for hot section applications, an optical system for viewing the interior of a combustor during operation, thin film sensors for surface temperature and strain measurements, and high temperature strain measuring systems. The paper describes the state of the development of these sensors and measuring systems and, in some cases, will show examples of measurements made with this instrumentation.The paper covers work done at the

NASA Lewis Research Center and at various contract and grant facilities.

22350 **(N—88-14447) Advanced fabrication techniques for hydrogen-cooled engine structures. Final report, October 1975-June 1982.** Buchmann, O.A.; Arefian, V.V.; Warren, H.A.; Vuigner, A.A.; Pohlman, M.J. (Allied-Signal Aerospace Co., Torrance, CA (USA). AiResearch Los Angeles Div.). Nov 1985. 123p. (NASA-CR—3949; NAS—1.26:3949; AMC—81-17928). NTIS, PC A06/MF A01.

Described is a program for development of coolant passage geometries, material systems, and joining processes that will produce long-life hydrogen-cooled structures for scramjet applications. Tests were performed to establish basic material properties, and samples constructed and evaluated to substantiate fabrication processes and inspection techniques. Results of the study show that the basic goal of increasing the life of hydrogen-cooled structures two orders of magnitude relative to that of the Hypersonic Research Engine can be reached with available means. Estimated life is 19000 cycles for the channels and 16000 cycles for pin-fin coolant passage configurations using Nickel 201. Additional research is required to establish the fatigue characteristics of dissimilar-metal coolant passages (Nickel 201/Inconel 718) and to investigate the embrittling effects of the hydrogen coolant.

22351 **(PB—88-132196/XAB) Combustion Engineering's furnace sorbent-injection programs for SO_2 control.** Koucky, R.W.; Gogineni, M.R.; Marion, J.L. (Combustion Engineering, Inc., Windsor, CT (USA)). Nov 1987. 25p. NTIS, PC A03/MF A01.

The paper discusses three Combustion Engineering programs relating to the furnace sorbent injection process, a low-cost method for controlling sulfur dioxide (SO_2) emissions from tangentially fired, coal burning boilers. The programs are: (1) pilot-scale investigations in the laboratory, (2) a prototype-scale program in a 65-MW utility boiler, and (3) a demonstration-scale program in a 180-MW utility boiler. A primary application of the technology is for retrofitting existing boilers in response to expected U.S. legislation for control of acid rain. In the process, the sorbent, usually calcium hydroxide ($Ca(OH)_2$) or limestone ($CaCO_3$), is injected above the flame zone where it mixes with flue gas containing SO_2. The SO_2 reacts chemically in the upper furnace with lime (CaO), formed from the sorbent, to make solid calcium sulfate ($CaSO_4$). The $CaSO_4$ is removed with fly ash in existing particulate control equipment.

22352 **(PB—88-143219/XAB) Mitsubishi Juko Giho, Vol. 24, No. 5, 1987.** (Mitsubishi Heavy Industries Ltd., Tokyo (Japan)). 1987. 128p. NTIS, PC E06.

Text in Japanese with English abstracts and illustration notes. See also PB—88-143227 through PB—88-143243 and PB—87-225918.

Tables of Contents include: MACH NDE system: state-of-the-art NDE technologies to realize life-extension program; Diagnostic system based on vibration measurement for rotating machines; Efficiency improvement of turbine in service by new technology (illustration); Daily start and stop operation of the existing supercritical-pressure-operation boiler; Design of coal-fired vertical-water-wall tube-type supercritical variable-pressure-operation boiler for Kyushu EPCO Matuura no. 1 unit; Design of LNG-fired USC steam generator for units nos. 1 and 2 of Kawagoe Power Station, Chubu Electric Power Co., Inc.; Mitsubishi-Lurgi circulating fluid-bed boiler; Recovery boiler with higher pressure, temperature and thermal efficiency; Development of remote-controlled repair system for boiler superheater and reheater tubing; Application of super 9 Cr steel large-diameter and thick-wall pipes; Development of welding technique for intermediate heat exchanger for HTGR; Development of fixed-bed-type hot-gas clean-up technology for coal-derived gas; Development of visual sensor for gas shielded arc welding; Development of portable imaging displayed ultrasonic examination system; Investigation on improvement of aluminum vacuum-brazing process; Development of high-speed precious press (illustration); Mitsubishi new 4WD, 4SW, 4IS integrated system (illustration).

22353 **(PB—88-143821/XAB) Modifying combustion kinetics by photodissociation of inhibitors. Final report.** Lavid, M.; Blair, D.W.; Stevens, J.G. (M.L. Energia, Inc., Princeton, NJ (USA)). 31 Jul 1985. 37p. NTIS, PC A03/MF A01.

This research demonstrated the feasibility of improving combustion by selectively modifying its kinetics, promoting combustion through photodissociation of reaction-inhibiting species into reactive radicals which participate in chain-branching reactions. This was tested in the H_2/air system by investigating its capability to extend the second explosion limit. The research demonstrated that the photodissociation of the metastable radical HO_2, $HO_2 + h\nu$ yields $OH + O$, can effectively compete with the terminating reactions. Experiments were conducted in both quartz and Pyrex reactors over a range of equivalence ratios from 0.2 to 1.2. The ultraviolet sources were high-pressure xenon arc lamps with their output filtered to retain only wavelengths strongly absorbed by HO_2. The experiments were also theoretically investigated and agreement between experimental data and modeling results was excellent.

4230 Marine Engineering

22354 (N—88-13609, pp vp) **System identification technique based on the random decrement signatures. Part 2: Experimental results.** Bedewi, N.E.; Yang, J.C.S. (Maryland Univ., College Park). Oct 1987. NTIS, PC A21/MF A01. (NASA-CP—2488-VOL-1; M—571-VOL-1; NAS—1.55:2488-VOL-1; CONF-8710126—).

From 58. shock and vibration symposium; Huntsville, AL, USA (13 Oct 1987).

Identification of the system parameters of a randomly excited structure may be treated using a variety of statistical techniques. Of all these techniques, the Random Decrement is unique in that it provides the homogeneous component of the system response. Using this quality, a system identification technique was developed based on a least-squares fit of the signatures to estimate the mass, damping, and stiffness matrices of a linear randomly excited system. The results of an experiment conducted on an offshore platform scale model to verify the validity of the technique and to demonstrate its application in damage detection are presented.

4240 Pollution Control Equipment

22355 **(PB—88-137534/XAB) Fossil- and nonfossil-fueled-fired industrial boilers - background information for promulgated SO_2 standards. Volume 4. Final report.** (Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards). Sep 1987. 240p. (EPA—450/3-87/024). NTIS, PC A11/MF A01.

See also Volume 3, PB—87-136800.

This document summarizes EPA's response to public comments received on proposed new source performance standards for sulfur dioxide emissions from new coal- and oil-fired industrial-commercial-institutional steam-generating units and particulate-matter emissions from oil-fired units (51 FR 22384, June 19, 1986). Alternative SO_2 control technologies and regulatory options are discussed in terms of SO_2 emission reduction capability, costs of control, secondary environmental impacts, national impacts, industry-specific economic impacts, emerging technologies, and monitoring, recordkeeping, and reporting requirements. In addition, the impacts of allowing emission credits for cogeneration and mixed-fuel-fired steam-generating units are reviewed. This document is intended to serve as an overview of the analyses and regulatory alternatives considered during the standards development process.

22356 **(PB—88-140546/XAB) Rotary-kiln incineration: the effect of oxygen enrichment on formation of transient puffs during batch introduction of hazardous wastes. Report for October 1986-October 1987.** Linak, W.P.; McSorley, J.A.; Wendt, J.O.L.; Dunn, J.E. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). Dec 1987. 26p. (EPA—600/D-87/358). NTIS, PC A03/MF A01.

The paper discusses results of experiments on a 73-kW (250,000 Btu/hr) rotary-kiln incinerator simulator equipped with a prototype oxygen enrichment burner, to determine the effect of oxygen enrichment on the magnitude and intensity of transient puffs emitted during batch introduction of contained liquid surrogate waste (toluene) on corncob sorbent. Results show that the effect of oxygen enrichment at constant temperature is to decrease the size of the transient puff, but that increases in kiln temperature associated with oxygen enrichment can offset this and cause net increases in the transient emissions. The effect is likely due to increases in the rate of waste volatilization. These results were especially true for particulate matter and are consistent with previous results without oxygen enrichment.

22357 **(PB—88-148408/XAB) Mathematical model for fabric filtration with integral particle charging and collection in a combined electric and flow field.** Plaks, N. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). Dec 1987. 20p. (EPA—600/D-87/363). NTIS, PC A03/MF A01.

This paper describes a mathematical model for fabric filtration with integral particle charging and collection in a combined electric and flow field. The model computes the non-uniform dust-cake formation as a function of the average gas-to-cloth ratio, bag diameter and length, electrical conditions (voltage and current), and particle-size distribution. The model is useful as an engineering tool for predicting performance for fabric-filtration baghouses using integral particle charging and collection and can be applied to any further development of the technology that may be undertaken.

4250 Power Cycles

22358 (NEDOJ—8401, pp 715-728) **Development of general-purpose Stirling engines.** Aug 1984. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770050/JAW.

In FY 1983 NEDO Annual Report.

In search of substitute energy for petroleum and for energy saving, heat pumps for heating and air-conditioning and stirling engines to adapt to small types of power source were researched, as well as their utilization system. By this research, a footing for practical application has been acquired. For aforesaid purpose, research was conducted for designing study of an optimum type of engine. At the same time, sealing device, burners, heat exchangers, output fetch system, output control technique and so forth were studied and developed. In more detail, starting in 1983 and continuing in 1984, 4 types of stirling engines for heating and air-conditioning were designed for element studies, consisting of small 3-kw class, and 30-kw class types. At the same time, research was also made in the application system of general-purpose stirling engines. (22 figs, 2 tabs)

22359 (NEDOJ—8603, pp vp) **Progress on 3 KW class stirling engine and heat-pump system.** Nomaguchi, T.; Suganami, T.; Fujiwara, M.; Sakai, M.; Kazumoto, Y.; Koseki, H.; Kawajiri, K.; Hisamori, Y.; Taketo, K.; Yoshida, T. (Mitsubishi Electric Corp., Amagasaki, Japan). 1986. New Energy Development Organization, Tokyo, Japan.

In FY 1986 NEDO Technical Report.

The base engine made in 1984 had the power of 3.2kW with 31.6% efficiency at 800rpm. In the engine designed in 1985, a combustor with a combustion capacity of 1.4 times of the rated capacity (10kW) was designed. Improvements were made for the ignitor arrangement, burner tile, and insulation. Trading off of the heat transfer and flow loss characteristics in the heat exchanger, relation of indicated power ratio and rotational speed were studied and reported in connection with 6 equations. Cooler pipes were installed dense to minimize the size of the manifold. Reduction in weight and size of the crank case was successfully performed. The endurance test for mechanical seal reached to about 3,200 hours continuous operation. Although the stroke volume of power piston was reduced to 75% of the previous one, the output power attained the same level with the previous engine. The study of stirling engine heat pump system has just started to realize the practical heat pump system. (12 figs, 3 tabs)

22360 (NEDOJ—8603, pp vp) **3 kW class stirling engine and heat pump system.** Nomaguchi, T.; Suganami, T.; Fujiwara, M.; Sakai, M.; Kazumoto, Y.; Koseki, H.; Kawajiri, K.; Taketo, K.; Yoshida, T.; Koda, T. (Mitsubishi Electric Corp., Amagasaki, Japan). 1986. New Energy Development Organization, Tokyo, Japan.

In FY 1986 NEDO Technical Report.

This paper describes the present state of the development program of a 3 kW class Stirling engine and a heat pump system. The program is a part of "Research and Development of a stirling Engine" program of NEDO. The 1985 engine was reduced to about 50% in weight and 70% in height as compared with the previous engine. For the combustor, ignitor arrangement was improved, and the fine ceramic board was installed as the burner tile to promote its thermal reliability. Simple annular tube type cooler design has proved to have the equivalent performance to the previous one. The displacer and the power piston shapes were much simplified as compared with the previous engine. The sufficient seal level for an indicated power is procured. An engineering mode of Stirling engine heat pump system was constructed to define technical issues associated with the system using the engine. (12 figs, 3 tabs)

43 PARTICLE ACCELERATORS

22361 **(SLAC-PUB—4456) A perspective on future accelerators.** Richter, B. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Oct 1987. Contract AC03-76SF00515. 5p. (CONF-8710107—3). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005878/JAW.

From Future perspectives in high energy physics; Upton, NY, USA (5 Oct 1987).

Some of the physics and technical issues are discussed which must be resolved before a future linear collider can be built. These issues include the center of mass energy and luminosity required for research in the range desired, length and power requirements, and cost. It is proposed that research and development of such a machine should be done internationally. (LEW)

22362 **Application of accelerators in research and industry '86: Proceedings, Part 2.** Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). 530p. (CONF-861114—Pt.2). Elsevier Science Publishers, 52 Vanderbilt Ave., New York, NY 10017. Order Number TI88006088/JAW. Contract FG05-86ER40303.

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Separate abstracts were prepared for 114 papers in these conference proceedings. (LEW)

22363 **Application of accelerators in research and industry '86: Proceedings, Part 1.** Duggan, J.L.; Morgan, I.L. (eds.). Amsterdam, Netherlands; North-Holland Physics Publishing Division (1987). 637p. (CONF-861114—Pt.1). Elsevier Science Publishers, 52 Vanderbilt Ave., New York, NY 10017. Order Number TI88005966/JAW. Contract FG05-86ER40303.

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Separate abstracts were prepared for 140 papers in this volume of the conference proceedings. Topics covered in this volume include atomic physics and related phenomena, synchrotron experiments, nuclear physics, ion implantation, semiconductors, materials modification and analysis. (LEW)

4301 Design, Development, And Operation

REFER ALSO TO CITATION(S) 22389, 23564, 23719, 23887

22364 (CEA-N—2531) Design and construction of superconducting helix cavities for heavy-ion acceleration. Ramstein, G. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Nucleaire a Basse Energie). Sep 1987. 165p. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88752142/JAW.

In a first step we shall investigate the grounds which led us to define the characteristic values of beam energy and spread for the tandem Van de Graaf Booster. We have very accurately measured by the perturbation method the electromagnetic field distribution for the fundamental mode inside the cavity. We have been obliged to use an experimental method because the lack of axial symmetry does not allow us to compute the field distribution with a good accuracy. Characteristic parameters as: shunt impedance, geometrical factor. Q value have been measured. From these measurements we have optimized the helix geometry and estimated the energy gain per charge. The liquid helium temperature properties of the cavity have been measured. The main parameter is then the Q value. We measured it at different field levels, and we used second sound wave propagation in superfluid helium to determine the spot position where the increase of temperature leads to quench. The variations of the eigen-frequency of the resonators have been investigated. We have also estimated the RF losses due to the trapped magnetic flux (Meissner Effect). To realize construction prototype cavities we have investigated the resonance frequency dependence upon the geometrical parameters. We have also tested the slow tuning system which tunes the cavity by mechanical deformation of the helix. The prototype cavity with an ion beam has been tested, we have checked the behaviour of the transit time factor and studied the optic along the beam transport line.

22365 (CRN-PN—86-34) Study and characteristics of a VIVITRON type electrostatic accelerator. Tancogne-Dejean, J.P. (Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires; Strasbourg-1 Univ., 67 (France)). Dec 1986. 131p. (In French). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88752106/JAW.

The conception of the 2 MV tandem electrostatic accelerator ARAMIS, which is intended for research in solid state and astrophysics, benefits from certain technological advances of the VIVITRON. Our study has dealt with the shape and arrangement of the column electrodes for this machine. We have employed the program Poisson which performs two-dimensional calculations of the electrical constraint at the surface of the conductors. The maximum field strength on the constrained regions has a value of 11.5 MV/m. This completely acceptable result let one expect that the machine operation will be satisfactory. Certain limitations inherent in the bidimensional calculations have led us to consider programs treating three dimensions. Access to the finite element library MODULEF at the Centre de Calcul in Strasbourg has increased the computational possibilities. The case of an insulating post in the coaxial terminal-tank structure has thus been treated. This work has allowed the construction of the column electrodes to proceed. They will be ready the beginning 1987. The tandem ARAMIS being built should be operational by the end of 1987.

22366 (DOE/ER/40150—40) CEBAF [Continuous Electron Beam Accelerator Facility] design overview and project status. Leemann, C. (Continuous Electron Beam Accelerator Facility, Newport News, VA (USA)). 1988. Contract AC05-84ER40150. 24p. (CEBAF-PR—88-001). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006309/JAW.

This paper discusses the design and specifications of the Continuous Electron Beam Accelerator Facility. Beam performance objectives are discussed, as well as the recirculating linac concept, the injector, cavities, cryogenic system, beam transport and optics, rf system and construction progress. 19 refs., 10 figs. (LSP)

22367 (FNAL-TM—1505) Fermilab D-0 Experimental Facility: Energy conservation report and mechanical systems design optimization and cost analysis study. Krstulovich, S.F. (Fermi National Accelerator Lab., Batavia, IL (USA)). 31 Oct 1987. Contract AC02-76CH03000. 178p. NTIS, PC A09. Order Number DE88006252/JAW.

This report is developed as part of the Fermilab D-0 Experimental Facility Project Title II Design Documentation Update. As such, it concentrates primarily on HVAC mechanical systems design optimization and cost analysis.

22368 (INFN/AE—87-2) The European Hadron Facility. Bradamante, F. (Trieste Univ. (Italy). Dipartimento di Fisica; Istituto Nazionale di Fisica Nucleare, Trieste (Italy)). 16 Mar 1987. 38p. (CONF-870260—15). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88900307/JAW.

From International workshop on hadron facility technology; Santa Fe, NM, USA (2 Feb 1987).

This paper discusses the design and development of the European Hadron Facility (EHF). This is a new research facility for nuclear and particle physics which is proposed for Western Europe in the 1990's. It consists of a complex of accelerators to produce a high-intensity (100μA) proton beam of 30 GeV kinetic energy, and is meant to provide a broad range of intense, high-quality secondary beams of neutrinos, muons, pions, kaons and antiprotons. A distinctive feature of this machine is that it has been designed to accelerate polarized proton beams to full energy. 30 refs., 10 figs., 7 tabs.

22369 (JINR—R-7-86-322, pp 72) ITs-100 heavy ion cyclic implantator. Flerov, G.N.; Andriyanov, A.M.; Bogomolov, S.L. 1986. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780065/JAW.

In Heavy ion physics - 1985. Collection of annotations of the Nuclear Reaction Laboratory of the Joint Nuclear Research Institute works, 1985.

22370 (JINR—R-7-86-322, pp 73) Production of /sup 14/C accelerated ion beams on the U-300 cyclotron. Efremov, A.A.; Ivanenko, A.I.; Ivanov, Yu.A.; Koval'chuk, I.M.; Kutner, V.B.; Oganesyan, Yu.P.; Penionzhkevich, Yu.Eh.; Pronin, N.V.; Tumanov, K.L. 1986. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780065/JAW.

In Heavy ion physics - 1985. Collection of annotations of the Nuclear Reaction Laboratory of the Joint Nuclear Research Institute works, 1985.

22371 (KEK—86-5) Design and rf tuning of the KEK 40 MeV proton linear accelerator. Kato, T. (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)). Sep 1986. 63p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE87703006/JAW.

An Alvarez linac was designed and constructed on the basis of a model linac study to increase the output energy from 20 to 40 MeV. The linac was tuned by frequency tuners and post couplers. Stabilization of the field was achieved and a variation within +- 0.7 % of the accelerating field was obtained. An equivalent circuit analysis which can numerically solve loop equations, including stem and post currents in addition to tank current, can explain the rf characteristics of a postcoupled structure.

22372 (NIKHEF-K-LINO—137) Program of energy saving measures at NIKHEF-MEA. Lely, U.P. (DHV Raadgevend Ingenieursbureau BV, Amersfoort (Netherlands); Nationaal Inst. voor Kernfysica en Hoge-Energiefysica (NIKHEF), Amsterdam (Netherlands). Sectie K). May 1986. 55p. (In Dutch). NTIS (US Sales Only), PC A04/MF A01. Order Number TI88701776/JAW.

In this report a package of energy-saving measures for NIKHEF-MEA are presented. The proposed measures have reference to the raising, in relatively short time, of the modulation frequency to the desired value when, in behalf of maintenance or tuning the repetition frequency is set low. A second group of measures consists in the limitation of the energy consumption of the

cooling systems at MEA and AFBU. At MEA important economizations can be achieved by the limitation of the heat-leaching to outside when the accelerator is out of operation while at AFBU the tuning of the r.p.m. of the circulation pumps in the cooling systems seems to be attractive. As least measure of the package the power control of NIKHEF is incorporated. This should allow for exploiting the available power as economical as possible and for keeping the costs for electricity supply as low as possible. 4 tabs.

22373 **(PB—88-128772/XAB) Superconducting accelerating structures for the acceleration and deceleration in the harmonic region. Final report.** Delayen, J.R. (Applied Superconductivity, Inc., Altadena, CA (USA)). Sep 1985. 14p. NTIS, PC A03/MF A01.

Existing superconducting accelerating structures for heavy ions are restricted to ion velocities of at least 0.03 c, requiring the ions to be preaccelerated by an electrostatic accelerator. There has been a growing interest recently in resonators capable of accelerating extremely low-velocity ions (less than 0.01 c); these would allow the elimination of the electrostatic injector. It was found that a combination of two resonators operating at 50 MHz and optimized for velocities of 0.01 and 0.016 could accelerate ions from 0.007 c to 0.03 c in the harmonic region, and to much higher velocity in their fundamental region. An analytical study of the acceleration process inside the resonator found the energy gain to be very different from that given by the usual first order approximation where the velocity is assumed to be constant. Of great importance to these very-low-velocity, harmonic resonators is the fact that substantial energy gain can still be obtained at the zeroes of the transit-time factor. An electromagnetic design of a 50 MHz, beta-0.01 resonator was performed.

22374 **Plasma opening switch development for the Particle Beam Fusion Accelerator II (PBFA II).** Stinnett, R.W.; McDaniel, D.H.; Rochau, G.E.; Moore, W.B.; Gray, E.W.; Renk, T.J.; Woodall, H.N.; Hussey, T.W.; Payne, S.S.; Commisso, R.J. (Sandia National Labs., Albuquerque, NM 87185). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science;* **PS-15**: No. 5, 557-563(Oct 1987).

The authors conducted plasma opening switch (POS) experiments on Sandia National Laboratories' new Particle Beam Fusin Accelerator II (PBFA II) (12 MV, 100 TW, 50 ns), on the Supermite accelerator (2 MV, 2 TW, 50 ns) and on the Naval Research Laboratory's Gamble II accelerator (1.8 MV, 1.6 TW, 70 ns). The POS systems on the PBFA II and Supermite accelerators use a newly developed flashboard plasma source to provide the plasma necessary to conduct the large (> 1 MA) currents produced byu these accelerators. In the Supermite experiments, the plasma opening switch conducted currents up to 1 MA before opening in less than 10 ns into an electron beam load. These experiments achieved significant voltage gain relative to the voltage across a matched load. In experiments on Gamble II, power gains of up to 1.7 were achieved using a POS in a strongly coaxial geometry (r/sub outer// r/sub inner/ = 2) with a large magnetic field at the cathode. The POS system on PBFA II is unique because of its size and voltage. This POS system is designed to conduct over 6 MA before opening. In present experiments it has conducted currents of 4-5 MA for over 50 ns.

22375 **Plasma-filled diode experiments on PBFA-II.** Renk, T.J.; Rochau, G.E.; McDaniel, D.H.; Moore, W.B.; Zuchowski, N.; Padilla, R. (Sandia National Labs., Albuquerque, NM 87185). pp 48 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—). Contract AC04-76DP00789.

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

The PBFA-II accelerator is designed to use a Plasma Opening Switch (POS) for pulse shaping and voltage multiplication using inductive storage. The vacuum section of the machine consists of a set of short magnetically insulated transmission lines (MITLs) that both act as a voltage adder for series stacking of the pulses out of the 72 parallel plate water lines, and as a 100 nH (total) storage inductor upstream of a biconically shaped POS region. There are two POS plasma injection areas, located above and below an equatorial load, which has consisted of either a short circuit, a blade (electron beam) diode, or an Applied B magnetically insulated ion diode. The POS is designed to conduct up to 6 MA, and open into a 5 ohm diode load in 10 ns or less. Under these conditions, the voltage at the load is predicted to exceed 24 MV. Initial POS experiments using these loads have produced 1) opening times of typically 20 ns or longer, 2) poor current transfer efficiency (less than 50%) when load impedances averaged 2 ohms or more, and 3) differential switch opening in azimuthal segments of the power feed, thought to be caused by poor plasma uniformity across the flashboard plasma source. One possible explanation for 2) is that efficient transfer out of the POS requires that the current carried to the load be magnetically insulated, or else considerable energy will be deposited in the feed region between the POS and load. This had indeed been observed. The problem is further exacerbated by the longer current turn-on times that occur when an ion diode is used as the load.

22376 **Acceleration of protons or electrons by the counterstreaming-electron-beam accelerators.** Yan, Y.T. (Los Alamos National Lab., Los Alamos, NM 87545). pp 58-59 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

A novel advanced accelerator is proposed. The counterstreaming-electron-beam accelerator relies on the same physical mechanism as the plasma accelerator but replaces the stationary plasma in the plasma accelerator by a magnetized relativistic electron beam, drifting anti-parallel to the driving source and the driven beam, as the wave supporting medium. Similar to the plasma wakefield accelerator (PWFA), the plasma wave in a counterstreaming electron beam can be excited by a shaped driving electron beam. This is called the Counterstreaming-Electron-Beam Wakefield Accelerator (CWFA). Similar to the plasma beat-wave accelerator (PBWA), the plasma wave in a counterstreaming electron beam can also be excited by properly beating two laser beams. This is called the Counterstreaming-Electron-Beam Beat-Wave Accelerator (CBWA).

4302 Beam Dynamics, Field Calculations, And Ion Optics

REFER ALSO TO CITATION(S) 22406, 23721, 23722

22377 **(CEA-N—2529) Beam optics and dynamics of the Saclay heavy ion booster.** Valero, S. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Nucleaire a Basse Energie). Aug 1987. 261p. (In French). NTIS (US Sales Only), PC A12/MF A01. Order Number DE88752112/JAW.

The purpose of this paper is to give to users: experimental physicists, engineers and technicians involved in the machine operation a good understanding of the beam properties of the helical cavities used in the Saclay superconducting heavy ion linac.

22378 **(DOE/ER/40150—43) Perturbation method for calculation of narrow-band impedance and trapped modes.** Heifets, S.A. (Continuous Electron Beam Accelerator Facility, Newport News, VA (USA)). 19 Aug 1987. Contract AC05-84ER40150. 19p. (CEBAF-PR—87-031). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006312/JAW.

An iterative method for calculation of the narrow-band impedance is described for a system with a small variation in boundary conditions, so that the variation can be considered as a perturbation. The results are compared with numeric calculations. The method is used to relate the origin of the trapped modes with the degeneracy of the spectrum of an unperturbed system. The method also can be applied to transverse impedance calculations. 6 refs., 6 figs., 1 tab.

22379 (ITEF—6(1987)) Numerical-analytical method for calculating three-dimensional near-axis fields in structures with space-homogeneous quadrupolar focusing on base of the Shwartz technique. Balabin, A.I.; Khapalov, S.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701636/JAW.

Numerical-analytical method for calculating accelerating-focusng fields in structures with space-homogeneous quadrupolar focusing is described in short. Example of concrete realization of the method suggested for modeling of three-dimensional quasistationary fields in structures with cylindrical electrodes of a variable diameter having conical adapter is given. The method considered has been realized in the POLE2 program (FORTRAN, BESM-6 computer). 5 figs.

22380 (JINR-R—9-86-608) Parametric resonance passage in intense electron-ion rings. Aleksakhin, Yu.I. (Joint Inst. for Nuclear Research, Dubna (USSR). Dept. of New Acceleration Methods). 1986. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87702988/JAW.

Submitted to the 10. All-union conference on charged particles accelerators (Dubna, Oct 1986).

The parametric resonance of the oscillations of the intense electron-ion ring axial dimension (quadrupole oscillations) as well as of the ring coherent dipole oscillations is considered. The ions are shown to make possible slow transversing of both quadrupole and dipole resonances with the oscillation frequency decreasing. In a purely electron ring its space charge allows slow crossing of the quadrupole resonance with the increasing frequency, but slow crossing in any direction of the dipole resonane leads to practically unlimited growth of the coherent oscillation amplitude. If the frequency changes rapidly then the gain in oscillation energy due to dipole resonance is negligible compared to that due to quadrupole resonance. It is noted that crossing of the resonances can be indicated by ring HF fields. 9 references.

22381 (JINR-R—11-87-49) Algorithm for accounting the conditions in infinity for two-dimensional magnetostatics problems. Ajryan, Eh.A.; Zhidkov, E.P.; Khoromskij, B.N.; Yuldashev, O.I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1987. 15p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701673/JAW.

An approach to solving magnetostatic two-dimensional problems in terms of one-component vector potential is developed. On the boundary of the ferromagnetic region the boundary integral equations (BIE) are used as a boundary condition. For the linear case and smooth coefficients of the differential equation the positiveness of differential opereator is proved. Two different approximations of the problem are considered. A unique solvability of the difference equation is proved. For the second difference approximation the positiveness of the difference operator is established. The algorithm proposed is especially efficient when solving of the differential equation (linear or nonlinear) in a limited region is a more difficult problem than solving BIE. Some numerical results are given. 25 refs.; 3 figs.; 3 tabs.

22382 (KFTI—87-30) Electrothermal instability in superconducting resonators. Belokhvostukov, A.N.; Repalov, N.S.; Khizhnyak, N.A. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1987. 5p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701684/JAW.

Combined solution of electrodynamics and heat transfer equations has been performed in the task of excitation of strong electromagnetic oscillations in superconducting resonator. Effect of heat transfer intensity on resonator resonance characteristics has been investigated. It is shown that electrothermal instability accompanied with pulsations of resonator wall temperature and electromagnetic field power level takes place in superconduction region. Resonator excitation stability criteria have been obtained as well as requirements to cryostatting system have been given. 3 refs.; 3 figs.

22383 (LAL-RT—87-05) Small disruption revisited. Perez Y Jorba, J. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France). Dept. de Recherches sur la Fusion Controlee). Jun 1987. 14p. (CONF-8706147—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88752120/JAW.

From Workshop on new developments in particle acceleration techniques; Orsay, France (29 Jun 1987).

An uniform cylindrical model is used to study beam-beam interaction at low values of disruption parameter. It is found that focussing is imperfect. Enhancement luminosity factors are computed and found smaller than in other models.

22384 (SAND—87-3068) Trajectory Code Studies, 1987. Poukey, J.W. (Sandia National Labs., Albuquerque, NM (USA)). Jan 1988. Contract AC04-76DP00789. 47p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006218/JAW.

The trajectory code TRAJ has been used extensively to study nonimmersed foilless electron diodes. The basic goal of the research is to design low-emittance injectors for electron linacs and propagation experiments. Systems studied during 1987 include Delphi, Recirc, and Troll. We also discuss a partly successful attempt to extend the same techniques to high currents (tens of kA). 7 refs., 30 figs.

22385 Molecular dynamics calculations on the crystallization of a cooled heavy ion beam in a storage ring. Rahman, A.; Schiffer, J.P.; Hasse, R.W. (Minnesota Univ., Minneapolis, USA. Supercomputer Inst.; Argonne National Lab., IL, USA; Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt, Germany, F.R.). *Verhandlungen der Deutschen Physikalischen Gesellschaft;* **23**: No. 6, H2.8(Mar 1988). (CONF-880347—).

From Spring meeting of the Fachausschuss Kern- und Mittelenergiephysik of the Deutsche Physikalische Gesellschaft e.V.; Berlin, F.R. Germany (21 Mar 1988).

22386 Temporal evolution of ion energy and acceleration mechanism in a plasma focus. Rhee, M.J.; Weidman, D.J. (Lab. for Plasma and Fusion Energy Studies, Univ. of Maryland, College Park, MD 20742). pp 45 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

The recent development of a time-resolving Thomson spectrometer permitted us to study the temporal evolution of plasma-focus produced ion energy. The spectrometer used in this study employed a 27.0 MHz, 550 V amplitude sinusoidal wave for the electric field and has an improved time resolution of a fraction of a nanosecond. The resulting spectrograms show oscillatory traces about the magnetic deflection axis with increasing amplitude as the magnetic deflection increases. The envelope of this amplitude coincides with the corresponding parabolas which would have been obtained in this time-integrating spectrometer. From this spectrogram, the authors determined the velocity and the arrival time at the spectrometer for each individual ion, and they constructed the distribution of ions in a velocity-time space.

22387 Time-resolved Thomson spectrometer measurement of plasma focus produced ions D.J. Weidman; Gonzales, J.I.; Rhee, M.J. (Lab. for Plasma and Fusion Energy Studies, Univ. of Maryland, College Park, MD 20742). pp 45 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

The authors used a time-resolving Thomson spectrometer to analyze the protons in the ion beam from a plasma focus. Previous experiments revealed the total time duration of their pulsed source to be about seven nanoseconds. In this work, the authors present a detailed distribution of ions in velocity-time space measured by

using a spectrometer system with improved time resolution. A conventional, time-integrating Thomson spectrometer consists of parallel E-vector and B-vector fields. By measuring particle deflection, the velocity, momentum, and charge-to-mass ratio can be determined for each particle.

22388 **Vacuum interface to a soft x-ray Synchrotron beam line.** Gong, P.P.; Thompson, R.T.; Smith, B.A. (Dept. of Detectors and Engineering, EG and G/EM Inc., Mail Stop N-22, P.O. Box 1912, Las Vegas, NV 89125). pp 218-222 of X-ray calibration: Techniques, sources and detectors. Rockett, P.D.; Lee, P. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1986). (CONF-860880—).

From 30. SPIE technical symposium on optics and optoelectronic engineering; San Diego, CA, USA (17 Aug 1986).

A versatile differential pumping system which consists of two independently pumped chambers connected with one of three interchangeable vacuum barriers and various optical elements is described. The three vacuum barriers are a straight tube collimator, a stainless steel capillary array, and a glass capillary array. The vacuum barriers were designed to handle different beam sizes, intensities, and vacuum isolation. The UHV chamber can reach a pressure below 5.0E-10 torr and can sustain a vacuum differential of greater than 1.0E 3 across the barrier. The main advantages of this system are the interchangeable vacuum barriers, the ability to provide control and analysis of the x-ray beam, and the quick ambient to vacuum turn around time.

22389 **Performance of oblique angle of incidence collection systems in the VUV.** Keller, G.L.; Scott, M.L.; Mitchell, K. (Univ. of California, Los Alamos National Lab., P.O. Box 1663, MS E523, Los Alamos, NM 87545). pp 231-237 of X-ray calibration: Techniques, sources and detectors. Rockett, P.D.; Lee, P. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1986). (CONF-860880—).

From 30. SPIE technical symposium on optics and optoelectronic engineering; San Diego, CA, USA (17 Aug 1986).

High rejection filters are difficult enough to achieve in the UV-VIS-IR with known materials and constants. Even more difficult is the design and manufacture of rejection filters in the EUV and VUV given the uncertainty of optical constants and their wide variation over this spectral range. The authors begun work to characterize materials from 584 A to 1,300 A to verify reported optical constants, in order to design and realize the optimum collection system.

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REFER ALSO TO CITATION(S) 22375, 23327, 23411

22390 **(AD-A—187056/7/XAB) Kratky block-collimation small-angle x-ray diffractometer for synchrotron radiation.** Chu, B.; Wu, D.Q.; Wu, C. (State Univ. of New York, Stony Brook (USA). Dept. of Chemistry). Jul 1987. 8p. NTIS, PC A02/MF A01.

Pub. in Rev. Sci. Instrum., Vol. 58, No. 7, 1158-1163(Jul 1987).

A block-slit collimation system of the Kratky design concept was modified and adapted for synchrotron radiation. The building block small-angle x-ray diffractometer (SAXD) not only retains the essential advantages of the Kratky camera, i.e., accessibility at small values of q/bar=(4 pi/Lamda)sin(theta/2) with lambda and theta being the x-ray wavelength and the scattering angle, respectively and ease alignment, but also provides portability and low construction cost. With the SAXD operating at the SUNY X21A beamline of the National Synchrotron Light Source, we were able to reach theta about 1 mrad corresponding to q about 0.04/nm (or a Bragg spacing of 150nm) using an incident slit width (d) of 0.5 mm and lambda=0.15nm. At d=0.5mm, about 10% of the monochromatic synchrotron x-ray radiation passed through the block-collimation system and a parasitic intensity to main beam intensity ratio of about .00001 at theta=1 mrad was achieved. With d about 0.1 mm, it is anticipated that q about 0.01/nm can be accessible. By changing the vacuum-tube length between the sample chamber and the beam stop from about 1400 to about 200mm, we could reach an intermediate q range of about 0.04 somewhat < q somewhat < 10/nm using a 5-cm-long linear position-sensitive detector with a resolution of about 100 micrometers/channel. A description of the SAXD and its operation is presented.

22391 **(CENBG—8711) Nuclear microprobe of the CENBG: the choices.** Llabador, Y. (Bordeaux-1 Univ., 33 - Gradignan (France). Centre d'Etudes Nucleaires). Apr 1987. 37p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752113/JAW.

A microbeam line with a spatial resolution of the micrometer order has been set on the Van de Graaf of the Bordeaux-Gradignan nuclear center. This report presents the different stages of the microprobe design: the experimental device which has been chosen, the reason of the different choices, the traps to keep out of during the construction (for instance, the accuracy of the mechanical standards).

22392 **(CONF-870955—3) Status of rf superconductivity at Argonne National Laboratory.** Markovich, P.M.; Shepard, K.W.; Zinkann, G.P. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 13p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005913/JAW.

From 3. workshop on RF superconductivity; Argonne, IL, USA (14 Sep 1987).

This paper reports the status of hardware development for the linac portion of the Argonne tandem-linac accelerator system (ATLAS). The ATLAS superconducting linac consists of an independent-phased array of 45 superconducting niobium resonators of the split-ring type. The linac has been operating in its present form since 1985, on a 24-hours per day, 5 days per week schedule. An upgrade of the ATLAS system is currently under construction the positive-ion injector (PII). The PII system will consist of an ECR positive-ion source mounted on a high-voltage platform injecting a very-low-velocity superconducting linac. The completed system will provide for the acceleration of beams of mass up to uranium, and will replace the tandem electrostatic accelerator as the injector for ATLAS. The status of resonator development for the superconducting linac is reported in this paper. Accelerating gradients in the existing ATLAS linac are currently limited by excessive heating and rf loss in the fast-tuning system associated with each superconducting resonator. Development of an upgraded fast-tuning system is also reported here. 7 refs., 5 figs.

22393 **(CONF-8709217—3) Status of the ATLAS Positive-Ion Injector Project.** Pardo, R.C.; Benaroya, R.; Billquist, P.J.; Bollinger, L.M.; Clifft, B.E.; Den Hartog, P.K.; Markovich, P.J.; Nixon, J.N.; Shepard, K.w.; Zinkann, G.P. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 16p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005915/JAW.

From SNEAP conference; Tallahassee, FL, USA (27 Sep 1987).

The goal of the Argonne Positive Ion Injector project is to replace the ATLAS tandem injector with a facility which will increase the beam currents presently available by a factor of 100 and to make available at ATLAS essentially all beams including uranium. The beam quality expected from the facility will be at least as good as that of the tandem based ATLAS. The project combines two relatively new technologies - the electron cyclotron resonance ion source, which provides high charge state ions at microampere currents, and RF superconductivity which has been shown to be capable of generating accelerating fields as high as 10 MV/m, resulting in an essentially new method of acceleration for low-energy heavy ions. 5 refs., 7 figs., 1 tabs.

22394 **(IFVE-OI—85-160) Computer code for tuning H-wave accelerating structure.** Barsukov, A.B. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1985. 9p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701050/JAW.

Spesific requirement for accelerating resonator structure is a close tolerance for uniformity of accelerating and focusing field

longitudinal distribution, that for H-cavity is equivalent to the tolerance for uniformity of HF-voltage at the ends of inner cutted tube. Inaccuracies in fabrication and mounting of the structure elements are the cause of its specified tuning and equalization of potentials at electrodes. Program algorithms for tuning the H-cavity accelerating structure have been described. The program is realized on the basis of axial-symmetric model of the cavity. The program provides for conversion of measured detuning in the voltage variation by the structure periods. Concrete calculational and experimental results obtained with the full scale model of the accelerating structure are given. 11 refs.; 2 figs.; 2 tabs.

22395 **(JINR—9-86-511) Layout and main parameters of the nuclotron slow extraction system.** Vasilishin, B.V.; Issinskij, I.B.; Mikhajlov, V.A.; Tarovik, M.N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1986. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87702965/JAW.

The fundamentals of the Nuclotron slow extraction system construction are presented. The Nuclotron is the synchrotron of relativistic nuclei. A slow extraction scheme with the use of nonlinear resonance 3Q/sub x/=20 is chosen, its main parameters are calculated, the extracted beam characteristics are given. Tolerances for space and time non-uniformities of the magnetic field are evaluated. 5 references, 4 figures, 1 table.

22396 **(JINR—9-86-512) Calculation of nuclotron magnetic structure.** Vasilishin, B.V.; Issinskij, I.B.; Mikhajlov, V.A.; Tarovik, M.N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1986. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87702966/JAW.

The Nuclotron is the accelerator facility of relativistic nuclei being under construction at JINR. The main requirements for synchrotron magnetic structure are formulated, and a few possible configurations are considered and optimal variant is chosen. Nuclotron magnetic structure includes 32 FODO type periods and 8 superperiods. The betatron frequences Q/sub x/—Q/sub z/—6.75. The chosen structure permits to place the Nuclotron ring in synchrophasotron building and to realize the beam injection and extraction in existing directions. 9 references, 9 figures, 1 table.

22397 **(JINR—13-87-371) Charged particle flux measurement and monitoring system calibration.** D'yachenko, V.M.; Mar'in, I.I.; Sosul'nikova, A.M.; Tolstov, K.D. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1987. 5p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701656/JAW.

Technique and results of its application for monitoring the beams of protons, deuterons, /sup 4/He and /sup 12/C ions accelerated at the Dubna synchrophasotron are described. The proposed technique allows measuring the extracted beams of charged particles with intensities from 10/sup 2/ particle/pulse to the maximum possible limit. In the first experiments the 2% standard deviation of intensity has been obtained. This accuracy can be improved. The technique can be used for calibrating the systems used for measuring the absolute intensity. 3 refs.; 5 figs.

22398 (JINR—R-7-86-322, pp 77) **Study on multicharged ion yield and measuring electron temperature in a cyclotron arc ion source.** Bogomolov, S.L.; Kutner, V.B.; Pasyuk, A.S. 1986. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780065/JAW.

In Heavy ion physics - 1985. Collection of annotations of the Nuclear Reaction Laboratory of the Joint Nuclear Research Institute works, 1985.

22399 (JINR—R-7-86-322, pp 78) **Multicharged ion production in a laser plasma and its acceleration in a cyclotron.** Pasyuk, A.S.; Kolesov, I.V.; Kutner, V.B. 1986. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780065/JAW.

In Heavy ion physics - 1985. Collection of annotations of the Nuclear Reaction Laboratory of the Joint Nuclear Research Institute works, 1985.

22400 (JINR—R-7-86-322, pp 69) **Automation of acquisition and processing of spectrometric information in the MT-22 microtron measuring center.** Zhuchko, V.E.; Glejbman, Eh.M. 1986. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780065/JAW.

In Heavy ion physics - 1985. Collection of annotations of the Nuclear Reaction Laboratory of the Joint Nuclear Research Institute works, 1985.

22401 (JINR—R-7-86-322, pp 85) **Data acquisition and control system of the facility for radiative study on strength properties.** Flerov, G.N.; Oganesyan, Yu.Ts.; Belov, A.G.; Starodub, G.Ya. 1986. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780065/JAW.

In Heavy ion physics - 1985. Collection of annotations of the Nuclear Reaction Laboratory of the Joint Nuclear Research Institute works, 1985.

22402 **(JINR-R—8-86-583) Nonlinear effects in superconducting magnet thermal regime simulation under pulse energy release.** Miklyaev, V.M.; Minashkin, V.F.; Selyunin, S.Yu.; Sergeev, I.A.; Skrypnik, A.V.; Filippov, Yu.P. (Joint Inst. for Nuclear Research, Dubna (USSR). Dept. of New Acceleration Methods). 1986. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87702986/JAW.

Submitted to the 13. International conference on high-energy particles accelerators (7-11 Aug 1986, Novosibirsk).

The results of experimental simulation of thermal regimes of superconducting magnet in the pooling mode of cooling under pulse energy release are presented. These results are obtained in 10 μs-1 min time range with 50 μs and more time resolution at 100 to 10000 W/m² heat flux values for 0.06-0.18 MPa pressures. For pulse power values near to the stationary critical loading under corresponding conditions the qualitatively new data on transient heat transfer to helium are obtained. The importance of presented data for calculations of superconducting magnetic systems is shown. 9 references, 10 figures.

22403 **(JINR-R—9-86-600) Possibility of application of the orbit expansion effect in beam extraction system of the TRIUMF cyclotron.** Borisov, O.N.; Dmitrievskij, V.P.; Kol'ga, V.V.; Lomakina, O.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1986. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87702987/JAW.

A principal possibility of application of the equilibrium orbit expansion effect (OEE) in the beam extraction systems with comparatively small magnetic field variation is shown. General consideration of this possibility is performed and numerical calculation of OEE in the H^- beam extraction system at the TRIUMF meson factory is carried out. The following parameters are studied: initial energy W=460 MeV, energy gain pair a turn ΔW=0.34 MeV, harmonic mode q=5, isochronous field at r=0 B_0=0.3016 T, maximum magnetic field B/sub max/=0.58 T. The effect of energy spread in the accelerated bunchs on the equilibrium orbit expansion process is considered. 7 references, 6 figures.

22404 **(JINR-R—9-87-365) Application of magnetic barrier for increasing the efficiency of laser ion source.** Bykovskij, Yu.A.; Kozyrev, Yu.P.; Peklenkov, V.D.; Suvorov, K.G.; Vinogradov, V.G.; Pasyuk, A.S.; Pronin, N.V.; Stetsenko, S.G. (Moskovskij Inzhenerno-Fizicheskij Inst. (USSR); Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1987. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701669/JAW.

Some results on the investigation of quantitative and space-time characteristics of laser produced plasma dispersing in the non-uniform magnetic field are presented. The purpose of investigation was to consider a possibility of application of magnetic barrier in a laser ion source in order to rise the efficiency of ion extraction from plasma in this source. Investigations were carried out at the U-200 cyclotron and CO/sub 2/-laser was used. The obtained maxi-

mum pulse duration and maximum quantity of accelerated ion C/sub 12//sup 3+/ are 14 μs and 1.8x10/sup 10/ particle/pulse, respectively. These data exceed the results obtained earlier from the laser ion sources at the U-200-cyclotron. 5 refs.; 10 figs.

22405 **(JINR-R—13-86-734) Targets with frozen polarization of hydrogen and deuterium nuclei.** Borisov, N.S.; Bunyatova, Eh.I.; Kiselev, Yu.F.; Liburg, M.Yu.; Matafonov, V.N.; Neganov, B.S.; Neganov, A.B.; Usov, Yu.A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1986. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703004/JAW.

Submitted to the 7. International symposium on spin phenomena in high-energy physics, Protvino, 22-27 Sep 1986.

The basic principles and characteristics of the frozen spin orientation of proton and deuterium targets used in accelerators are described. The complex Cr(V) compounds in diols are used as target operating material. The structure and important characteristics of powerful ^{3}He/^{4}He dilution refrigerators are discussed, the system of polarization measurement is described. A characteristic feature of these targets is a long relaxation time (— 1000 h) of deuterium nuclei in magnetic fields of about 0.5 T. 24 references, 4 figures, 2 tables.

22406 **(LBL—23866) Emittance measurements on the LBL ECR source.** Clark, D.J. (Lawrence Berkeley Lab., CA (USA)). Nov 1987. Contract AC03-76SF00098. 15p. (CONF-8711107—7). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006347/JAW.

From International conference on ECR ion sources and their applications; East Lansing, MI, USA (16 Nov 1987).

Measurements of radial emittance and the upper limit of energy spread have been made using a scanning Faraday cup after a waist, on beams of oxygen, argon and krypton. The general features are that the divergence seen at the scanning cup shows a central core and tails on each side. The un-normalized emittance of the beam core decreases with increasing Q/A in a way that is not explained by simple assumptions about the plasma or extraction system. Data from an experimental 1 mm diameter extraction aperture indicates that plasma density is about the same as over the standard aperture, but that the plasma energy spread is reduced to an upper limit of .2 to .4 V, and beam brightness is up by a factor of 10 for medium charge states. 9 refs., 10 figs., 1 tab.

22407 **(LBL—24723) Towards portability in model-based control software.** Paxson, V.; Theil, E. (Lawrence Berkeley Lab., CA (USA)). Nov 1987. Contract AC03-76SF00098. 11p. (CONF-8708145—6). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006320/JAW.

From Workshop on model based accelerator controls; Upton, NY, USA (16 Aug 1987).

Two developments - that of model-based control systems in the accelerator community, and that of the X-Windows standard in the computer graphics community - have made it a realistic possibility that large bodies of high-level accelerator control software can be shared and reused throughout the accelerator community. To take advantage of these possibilities requires the discipline of truly modular software design, in which programs have very well-defined views of the data on which they operate and which they make available to the human interface software. If these programs are written with their knowledge of the rest of the control system restricted to simply exactly those things required for the task at hand, they can be easily detached and moved to other environments. We present a general design for producing portable control software, one which has been shown by experience to be effective. We are now using X-Windows so that our labor-intensive user-interface development efforts might prove as readily portable. If enough other members of the high energy physics community join in using the standard, we can over-come the final hurdle to large scale code-sharing. 4 refs., 6 figs.

22408 **The "mirrortron". An application of mirror physics principles to particle accelerators.** Post, R.F. (Lawrence Livermore National Lab., Univ. of California, Livermore, CA 94550). pp 62 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—). Contract W-7405-ENG-48.

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

An important aspect of fusion research is understanding the generation of electrical potentials through collective effects. Such potentials arise in all confinement systems, and play an essential role in the tandem mirror. This report addresses a related question: Could collective effects be employed within mirror-confined plasmas to generate very high potentials? If such is the case new types of particle accelerators might be developed for use in high energy research or in beam-driven inertial fusion systems. Concepts for using collective effects for particle acceleration date back several decades. Such concepts offer the promise of very high electric fields, but share a common problem: how to achieve precise control over the spatial and temporal variation of these potentials. Here this problem is to be solved by exploiting plasma quasineutrality in association with a transient magnetic field and ion inertial effects to create the potentials and to effect the required degree of control. The idea involves three elements: (1) a solenoidal "dc" magnetic field bounded at each end by moderate-height mirrors. (2) A low density (—10/sup 11/ cm/sup -3/) hot electron plasma. (3) A short oil located midway between the mirrors and capable of being pulsed to maximum field in —10 ms. This coil, segmented azimuthally to reduce voltage-handling problems, could use pulse technology such as that developed for the Livermore ATA accelerator.

22409 **Partition functions for railgun plasma armatures.** Rolader, G.E.; Batteh, J.H.; Desai, P. (Science Applications International Corp.). pp 85 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

In this paper the authors investigate the importance of properly accounting for the higher energy levels in calculating the properties of typical metal-plasma armatures. In particular, they compare the three methods for calculating the partition function based on their predictions for plasma composition, distribution of internal energy, pressure, and electrical conductivity. The plasma models used for the comparison are based on 'nonideal' plasma theory. The authors find that neglecting the contribution of the higher energy levels can lead to serious errors, particularly in the calculation of the electrical conductivity. In addition, it is shown that, while approximating the unknown levels as hydrogenic is better than neglecting them, only the energy levels with high orbital angular momentum are truly hydrogenic.

22410 **Solid discharge heavy ion fusion source studies.** Kiuttu, G.F.; Busby, K.O.; Brown, R.D.; Adler, R.J. (Mission Research Corp., 1720 Randolph Road, SE, Albuquerque, NM 87106). pp 80 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

Recent experiments have demonstrated the feasibility of solid discharges as ion sources for heavy ion fusion. In this paper, the authors summarize the findings of the preliminary feasibility study, discuss the results of more detailed experiments involving cloth fiber discharge sources, and present design data for a 500 kV, 0.5 A, 20 μsec, 1 Hz heavy ion discharge source. The solid discharge source feasibility experiments were carried out at acceleration voltages of 50 - 100 kV, current densities up to 1 A/cm/sup 2/, and pulse lengths of 2 - 3 μsec. The ion source in these experiments was low temperature plasma from a velvet cloth discharge cathode. The extracted and accelerated ions comprised roughly equal H/sup +/, C/sup +/, and O/sup +/ constituents, with lesser quantities of H/sup 2+/, C/sup 2+/, and O/sup -/. The plasma source temperature inferred from relative abundance was 2 -3 eV. The emittance for a 5 cm acceleration gap ion beam was estimated to be 5π mrad-

cm at a radius of 0.32 cm. In more recent studies with the same discharge source, the details of the discharge process have been examined. In particular, the correlation between the discharge gap voltage and current and the time evolution of the extracted ion species has been mapped. Additionally, the generation of higher atomic number ions by the same basic technique has been explored.

22411 **Electrohydrodynamically-driven liquid-lithium ion source for inertial confinement fusion.** Pregenzer, A.L.; Kingham, D.R. (Sandia National Labs., Albuquerque, NM 87185). pp 81 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—). Contract AC04-76DP00789.

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

Theory suggests that liquid-lithium and liquid-lithium nitrate can provide an electrohydrodynamically driven (EHD) ion source that uniformly produces ions on a nanosecond time scale. This work has prompted the development of large-area liquid-lithium and liquid-lithium nitrate ion sources to be used as drivers for inertial confinement fusion on the Particle Beam Fusion Accelerator II (PBFA II) at Sandia National Laboratories. This talk briefly reviews the concept of an EHD ion source and will describe recent theoretical work on ion emission, beam divergence, and the effects of space charge. The compatibility of available experimental results with EHD theory is discussed.

22412 **Mirror-based neutron source experiment.** Kesner, J.; Casey, J.A.; Gerver, M.J.; Golovato, S.N.; Horne, S.F.; Post, R.; Sevillano, E. (MIT Plasma Fusion Center, Cambridge, MA 02139). pp 63 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—). Contract AC02-78ET51013.

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

Mirror-based devices are ideally suited for use as fusion based engineering test facilities, because they have no scaling with size, are steady state, high beta, and have a cylindrical geometry leading to excellent accessibility. The difficulty of axial plugging which may limit the potential of mirrors as fusion reactors is unimportant for this application and, in fact, low confinement leads to high fusion power density. In considering a mirror based device in this context, the question that must be addressed is the ability of these devices to scale up in density and temperature while maintaining mHD and microstability. Axisymmetric devices are particularly interesting for this purpose. Central cell axisymmetry provides an excellent geometry for the testing modules. Furthermore axisymmetric coil design permits much higher fields to be generated by simpler and more efficient coils which results in a reduced beta. Additionally axisymmetry reduces radial transport. Recent successes in the Tara device have supported the feasibility of neutral beam injection into axisymmetric mirror cells. The authors discuss a proof-of-principle experiment based on the Tara facility. They will also present parameters for a mirror-based fusion component test facility and compare it with a Tokamak based facility.

4304 Storage Rings

REFER ALSO TO CITATION(S) 23728

22413 **Synchrotron radiation calibration of the SPRED VUV spectrograph at the NBS SURF II electron storage ring.** Stratton, B.C.; Fonck, R.J.; Ramsey, A.T. (Princeton Univ., Plasma Physics Lab., James Forrestal Campus, P.O. Box 451, Princeton, NJ 08544). pp 77-81 of X-ray calibration: Techniques, sources and detectors. Rockett, P.D.; Lee, P. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1986). (CONF-860880—).

From 30. SPIE technical symposium on optics and optoelectronic engineering; San Diego, CA, USA (17 Aug 1986).

An absolute intensity calibration of the SPRED VUV spectrograph currently in use on the Tokamak Fusion Test Reactor (TFTR) has been performed using synchrotron radiation from the NBS SURF II electron storage ring. Calibration results for both the 450-g/mm and 2100-g/mm gratings are presented and details of the calibration procedure are discussed.

44 INSTRUMENTATION

REFER ALSO TO CITATION(S) 22276

4401 Radiation Instrumentation

REFER ALSO TO CITATION(S) 21135, 22174, 22175, 22176, 22180, 22400, 22540, 23018, 23074, 23098, 23363, 23414, 23425, 23441, 23446, 23447, 23449, 23562, 23584, 23587, 23589, 23599, 23630, 23717, 23726, 23728, 23974, 23979, 23980, 23982, 23983

22414 **(AD-A—187431/2/XAB) Measurement of the gamma-ray response of some commercial silicon detectors.** McGowan, S. (Defence Research Establishment, Ottawa, Ontario (Canada)). Jun 1987. 30p. (DREO-R—958). NTIS, PC A03/MF A01.

This report gives the results of measurements of the response of some commercial photodiodes and particle detectors at monoenergetic gamma-ray sources. The absolute response and the response, as a function of photon energy, detector thickness and discriminator level, were investigated and are shown to be in general agreement with earlier calculations. It is concluded that, with appropriate photon filtration, the small photodiodes tested would be suitable for the relatively high dose-rate measurements of primary interest for military applications, although their thickness is greater than the thickness for best energy response.

22415 **(AD-A—187438/7/XAB) Thermoluminescence response of CaF_2:Mn, CaF_2:Dy and $CaSO_4$:Tm to protons and alpha particles.** McGowan, S.; Gravelle, R.A. (Defence Research Establishment, Ottawa, Ontario (Canada)). Jun 1987. 20p. (DREO-R—959). NTIS, PC A03/MF A01.

Proton/gamma and alpha/gamma response ratios were measured for very fine powders of the thermoluminescent phosphors CaF_2:Mn, CaF_2:Dy and $CaSO_4$:Tm. This has been done as Part of an evaluation of these phosphors for use in a combined neutron/gamma thermoluminescent dosimeter which is made neutron-sensitive by embedding the phosphor powder in an hydrogenous medium. The CaF_2:Mn phosphor was found to be marginally better than the other two for this purpose. Reduction in the measured proton/gamma response ratio with decreasing proton energy was attributed primarily to relatively low response near the surfaces of the phosphor particles.

22416 **(ATR—86(7098)-3) Restoration of particle pitch angle distribution functions by a maximum entropy algorithm.** Roeder, J.L.; Gorney, D.J. (Aerospace Corp., El Segundo, CA (USA)). Nov 1986. 31p. NTIS, PC A03/MF A01.

A technique is presented with which to analyze particle flux data in order to resolve features in the pitch angle distribution which are smaller than the angular response width of the detector. This process uses a large number of data points which overlap in pitch angle to construct a maximum entropy criterion for the true angular distribution at constant energy. Statistical arrors in the measured fluxes are allowed by the inclusion of a Chi-squared constraint in the calculation. Example electron distribution functions computed from SCATHA observation show loss cone gradients with widths of less than two degrees, with an instrument response of approximately six degrees. Models of both the original and the restored distributions are constructed as sums of bi-Maxwellians. The differences in the electrostatic stability of these models due to changes in the velocity gradients are discussed. This analysis may have applications for estimating beam, conic, and loss cone features in particle velocity distributions throughout the ionosphere and magnetosphere with significant consequences for wave-particle interactions.

22417 **(BMU—1987-165) Measurement of chemiluminescence of solids as possible indicator system for rapid dose assessment after radiation accidents.** Hammermaier, A.; Reich, E.; Boegl, W. (Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany, F.R.)). 1987. 124p. (In German). GRM Werbeberatung - Werbemittlung - PR, Eggenstein-Leopoldshafen,, Germany, F.R.

Schriftenreihe Reaktorsicherheit und Strahlenschutz. Ergebnisberichte, Untersuchungen, Studien, Gutachten.

14 different types of pharmaceutical tablets, 18 different pharmaceutical powders, and 32 other solid substances (foodstuffs, environmental materials, etc.) were tested as to their suitability for a rapid dose assessment by chemiluminescence measurement. The results from the examined pharmaceutical powders have shown after optimizing the test conditions that, in some pharmaceuticals, radiation doses of less than 1 Gy were still detectable. For pharmaceuticals in tablet form, the sample must be processed prior to chemilumescence measurement. This mechanical process strongly increases the chemiluminescence intensity also of non-irradiated samples and is thus responsible for deteriorating the detection limit. For examining the various solid substances, materials were selected which are non-soluble or only poorly soluble in luminol solution. All samples were exposed to a radiation dose of 100 Gy. When extrapolating on the basis of a linear dose-effect relationship into a lower dose range, it will be very difficult, to find any poorly soluble materials in the luminol solution which could indicate an exposure in the area of 10 Gy or below. This is mainly due to the fact that with insoluble samples the only reaction taking place is the one between the luminol solution and the radiolysis products on the surface.

22418 **(CEA-R—5397) Din - an indiviual neutron dosemeter.** Buxerolle, M. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France)). Sep 1987. 37p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752144/JAW.

An albedo neutron dosemeter with /sup 6/LiF and /sup 7/ Lif thermoluminescent detectors has been developed. A cadmium shield limits the effect of the distance from the body to the dosemeter and the effect of thermal neutrons scattered by the surroundings. The thickness of the cadmium filter has been adjusted so that the response is about the same for thermal neutrons (maxwellian) and epithermal neutrons (1/E spectrum with the energy E < 10 keV). The thermoluminescent detectors are enclosed in lead screens to reduce gamma background. The dosemeter offers improved characteristics in comparison with thermoluminescent detectors used without cadmium shields or with thick cadmium shields. It suffers from the strong energy dependence encountered with all albedo dosemeters and consequently a special calibration factor is required for each different working post.

22419 **(CEA-R—5412) Contribution to the study of aerosol aerodynamic behaviour - development of a diffusional and inertial spectrometer (SDI 2000).** Diouri, M. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Inst. de Protection et de Surete Nucleaire). Sep 1987. 251p. (In French). NTIS (US Sales Only), PC A12/MF A01. Order Number DE88752139/JAW.

A theoretical and experimental study of cascade impactor and particle diffusion on granular beds was carried out. It resulted in the development of a diffusional and inertial spectrometer (SDI 2000) covering a large particle size range (0.0075 - 15 μm). The second part of the study is devoted to an overview on data reduction and to a comparative study of linear, non-linear and simulation inversion methods adapted to cascade impactors. The inversion problem for SDI 2000 was solved. Finally, the particle size distributions of Diesel exhausts was determined. The possibility to characterize a radioactive aerosol with SDI 20000 was demonstrated, and the results of dust sampling with SDI 2000 inside the JET vessel (Joint European Torus) are presented.

22420 **(CENBG—8705) Chateau de Cristal data acquisition system.** Villard, M.M. (Bordeaux-1 Univ., 33 - Gradignan (France). Centre d'Etudes Nucleaires). May 1987. 7p. (CONF-870552—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88752127/JAW.

From 5. conference on real-time computer applications in nuclear, particle, and plasma physics; San Francisco, CA, USA (12 May 1987).

This data acquisition system is built on several dedicated data transfer busses: ADC data readout through the FERA bus, parallel data processing in two VME crates. High data rates and selectivities are performed via this acquisition structure and new developed processing units. The system modularity allows various experiments with additional detectors.

22421 **(EFI—945(96)-86) Some aspects of controllable nuclear emulsion.** Akopova, A.B.; Magradze, N.V.; Moiseenko, A.A.; Ovnanyan, K.M.; Chalabyan, T.S. (Erevanskij Fizicheskij Inst. (USSR)). 1986. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701556/JAW.

A technique for the control of sensitivity of 400 m-thick BR-and BYa-type nuclear emulsions is developed. A calibration experiment has been carried out using the traces of accelerated helium, carbon, nitrogen nuclei allowing for the use of 400 m-thick layers as detectors with controllable threshold of registration in the charged particles ionization losses range dE/dR=10/sup 1/-10/sup 4/ MeV/cm. A chemical oxidation regime of the developed layers is chosen which permits to obtain the specra of cosmic charged particles in the nuclear emulsion layers at an intensive background. Based on the previous works in a nuclear-emulsion stack exposed on board of "Kosmos-1571" satellite, the intensity of the absorbed radiation dose of 22.1 mrad/day has been determined. 7 refs.; 4 figs.

22422 **(EFI—946(97)-86) Improvement transition x-ray abilities in modern installations.** Avundzhyan, A.T.; Badalyan, S.G.; Bagdasaryan, L.S.; Kankanyan, S.A.; Khachatryan, A.A.; Oganesyan, A.G. (Erevanskij Fizicheskij Inst. (USSR)). 1986. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701557/JAW.

It is shown that in facilities containing except for calorimeters, muon and track detectors also detectors of X-ray transient radiation (XRTR) the latter are capable of carrying out simaltaneously particle identification and muon energy measurement. Four-module XRTR detector designed for hadron-electron rejection with a coefficient of an order of 300 at E/sub e,h/ <or approx. 30 GeV/c and ~ 30 at E/sub e,h/ ~ 100 GeV/c with electron detection efficiency of 90% has been considered. Each module contains a radiator and a multiwire proportional chamber. Polypropylene cotton was used as the radiator. 3 refs.; 3 figs.

22423 **(ENEA-RT-COMB—86-2) Fully automated system for Pu measurement by gamma spectrometry of alpha contaminated solid wastes.** Cresti, P.; Frazzoli, F.V.; Vicini, C. (ENEA, Rome (Italy)). 1986. 42p. (In Italian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700983/JAW.

A description is given of a fully automated system developed at Comb/Mepis Laboratories which is based on the detection of specific gamma signatures of Pu isotopes for monitoring Pu content in 15-25 l containers of low density (0.1 g/cm/sup 3/) wastes. The methodological approach is discussed; based on experimental data, an evaluation of the achievable performances (detection limit, precision, accuracy, etc.) is also given.

22424 **(FNAL/C—88/16-E) On Micro VAX farms and shower libraries: Monte Carlo techniques developed for the D0 detector.** Raja, R. (Fermi National Accelerator Lab., Batavia, IL (USA)). Jan 1988. Contract AC02-76CH03000. 30p. (CONF-8708186—4). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005962/JAW.

From Workshop on detector simulation for the SSC; Argonne, IL, USA (24 Aug 1987).

In order to predict correctly the effects of cracks and dead material in a nearly hermetic calorimeter, hadronic and electromagnetic showers need to be simulated accurately on a particle by particle basis. Tracking all the particles of all showers in the calorimeter leads to very large CPU times (typically 5 hours on a VAX780) for events at $\sqrt{(s)} = 2$TeV. Parametrizing the energy deposition of electromagnetic particles in showers with energy below 200 MeV

results in event times of the order of 1 hour on a VAX780. This is still unacceptably large. The D0 collaboration then employed a farm of 16 MicroVax II's to get acceptable throughputs. The calorimeter hit patterns of each individual track was output, to be summed up by a later job. These individual hit patterns were entered into a random access shower library file, which was then used for subsequent Monte Carlo simulations. This shower library technique results in further speed-ups of a factor of 60 without degrading the quality of simulation significantly.

22425 **(GANIL-R—87-01) Study and development of amplitude coder.** Tripon, M. (Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France)). Jun 1987. 154p. (In French). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88752111/JAW.

The lengthening door aimed to the memorization of the analog impulse peak delivered by the detectors has been developed in two versions. A converter with successive approximation was chosen whose very bad differential linearity has been corrected by the gliding scale method: a computer simulation allowed to characterize the correction efficiency. Two versions with eight impulse channel have been studied and developed.

22426 **(GSI—87-19) Technical proposal for a two arm photon spectrometer (TAPS).** Metag, V.; Simon, R.S.; High-Energy Photon Collaboration. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Nov 1987. 32p. NTIS (US Sales Only), PC A03/MF A01. Order Number TI88752466/JAW.

A BaF/sub 2/ scintillation spectrometer for the detection of high-energy photons is proposed. It will be operated in conjunction with particle detectors which provide exclusive triggers and event characterization. The photon detector system comprises 256 individual modules which are combined into 4 arrays of 64 elements each. The individual modules are hexagonal in cross section with an inscribed radius of 29.5 mm and have a length of 250 mm = 12 X/sub 0/. Neutron-γ separation will be accomplished by time-of-flight and pulse shape analysis, while charged particle discrimination is achieved by additional thin (0.05 X/sub 0/) plastic scintillation veto detectors in front of the BaF/sub 2/ elements.

22427 **(IAE—4372/15) Software for the KONUS-M on-line measurement system. Operation with a graphical display.** Vinogradov, A.A.; Solov'ev, V.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1986. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701037/JAW.

The use of the TD-3 graphical display in the "KONUS-M" on-line measurement system is described. "KONUS-M" is developed and used for conducting experiments on JINR synchrotron to study of relativistic heavy ion interactions with different nuclei-targets. The basic functional possibilities of TD-3 are given. Its operation in the mode of periodic and single output of alphanumeric and graphical data is described. Formates of data presentation, as well as operator commands introduced for efficient work with graphical data, are presented. 11 figs.

22428 **(IAE—4375/15) Software for the KONUS-M on-line measurement system. General discription and operator commands.** Solov'ev, V.A.; Tsvetkov, A.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1986. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701038/JAW.

Basic components of software for the "KONUS-M"-CONE on-line measurement system, designed for conducting experiments on JINR synchrophasotron for the study of relativistic heavy ion interactions with various nuclei-targets are described. Requirements to the CONE are formulated. Operation mode of the "KONUS-M" is described. Possibilities of the system when a user applies operator commands are shown. General notion of the structure of operating programs and table description of CAMAC units, which make the system independent of on-line processing algorithm changes and changes in the CAMAC equipment, is given. 7 figs.

22429 **(IAE—4414/2) High-selectivity scintillation spectrometer of antineutrinos.** Kopejkin, V.I.; Mikaehlyan, L.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1987. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701573/JAW.

A new design principle for a spectrometer of reactor antineutrinos ν-tilde/sub e/ using reverse β-decay reaction on proton is proposed. The detector consists of alternating plates of solid organic and heavy inorganic scintillators. Reaction positrons produced in the organic scintillator are selected by triple instantaneous coincidences (positron - two annihilation γ quanta). Delayed coincidence with neutron is detected by γ quanta occurred in the inorganic scintillator as a result of neutron capture. The expected detection efficiency is 25%. The counting rate of reverse β-decay events in the 1.3x10/sup 13/ ν-tilde/sub e/xcm/sup -2/xs/sup -1/ flux in a detector module containing 127 kg of polymethylmethacrylate is 200 events per 10/sup 5/ sec. 11 refs.; 1 fig.; 1 tab.

22430 **(IAE—4437/2) Scintillators for reactor neutrino detection.** Borovoj, A.A.; Perfilov, A.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1987. 5p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701574/JAW.

Basic characteristics of liquid scintillators used for neutrino detection at the Rovno NPP are given. It is shown that scintillators based on decalin and liquid paraffin mixture with gadolinium salt (0.5 g/l for metal) are optimal. The satisfactory spectral detector characteristics enable to measure energy of positrons emitted in the ν-tilde/sub e/+p->n + e/sup +/ reaction. Detection of γ radiation emitted as a result of slowed-down neutron capture by gadolinium is used for introduction of delayed coincidences and background suppression. 8 refs.; 3 tabs.

22431 **(IFVE-OEF—87-22) Study of light transmission methods from scintillators to optical fiber with wave length shifter.** Kryshkin, V.I.; Ronzhin, A.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701587/JAW.

Efficiency of light transmission and its transport from plastic scintillators to optical fiber with a wave length shifter has been investigated. Results of measuring the amount of photoelectrons for different geometrics of a wave length shifter and a light pipe are presented. Analysis of the results obtained has shown that to increase the light collection, use of multilayer optical fibers similar in structure is optimal. The best results on light collection are given with scintillator plates produced with the casting technique in which two-layer optical fiber is baked inside a scintillator. The count of electrons of 0.7 has been produced from each of two fiber edges. Inhomogeneity of response on plate dimensions (97x94x5 mm) constitutes +-0.7%. Results of investigation into light transmission methods have shown the advantage of optical-fiber light extraction in laminated calorimeters as compared with use of plate-wave length shifters. 7 refs.; 5 figs.

22432 **(IFVE-ONF—87-49) On possibility to use plastic tubes of DELPHI hadron calorimeters in proportional mode.** Akopdzhanov, G.A.; Sorokin, G.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. 8p. NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701591/JAW.

Specific features of the streamer tubes of the DELPHI hadron calorimeter operating in the proportional mode are considered. A possibility to reach their stable functioning in the proportional mode is shown. 7 refs.; 6 figs.

22433 **(INFN-FM—86-1) Study on HgI/sub 2/ nuclear detector.** Manfredotti, C.; Gabutti, A.; Gervino, G.; Monticone, E.; Nastasi, U. (Istituto Nazionale di Fisica Nucleare, Rome (Italy)). 1986. 14p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701061/JAW.

The electrical characteristics, the present state of-the art, the analysis of trapping and detrapping phenomena and the results of investigations on HgI/sub 2/ crystal are discussed. A calculation of the carrier drift-mobility, both cutting the crystal parallel and perpendicular to c-axis. Some X and gamma spectra obtained are presented and discussed with an evaluation of the total noise of our detection set-up.

22434 (INFN-LNF—87-70(R)) **Scintillation gas detector based on a charge coupled device. A feasibility study of a position sensitive detector for ESRF high brillance.** La Monaca, A. (Istituto Nazionale di Fisica Nucleare, Frascati (Italy). Lab. Nazionale di Frascati). (Istituto Nazionale di Fisica Nucleare, Rome (Italy)). 1987. 11p. NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701741/JAW.

A new imaging X-ray detector able to copy with the high photon flux of ESRF X-ray sources has been proposed. The detector has been based on scintillation gas chamber, which converts X-ray photon with a wavelength of 1.54 Angstrom in U.V. photons, coupled with a CCD, which detects in the position of the U.V. photons with wavelength greater than 1800 Angstrom. Using this detector, saturation effects due to the spatial charge of the avalanche discharge in the gas and radiation damage on the CCD, have been eliminated. A conical optical fibre system, collecting the U.V. photon flashes on CCD, magnyfying the detecting area of detector and allowing to obtain spatial resolution better than 0.3 mm, is suggested.

22435 (INIS-BR—934, pp 62) **Influence of anode geometry in the response of a gas proportional counter.** Tobias, C.C.B. (Pontificia Univ. Catolica de Sao Paulo, Brazil. Dept. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701471/JAW. (CONF-8708216—).

From 10. workshop on nuclear physics in Brazil; Caxambu, MG, Brazil (26 Aug 1987).

22436 (INIS-BR—934, pp 49) **BaF/sub 2/ scintillators: application to γ-rays and charged particles.** Saxena, R.N. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, Brazil). 1987. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701471/JAW. (CONF-8708216—).

From 10. workshop on nuclear physics in Brazil; Caxambu, MG, Brazil (26 Aug 1987).

22437 (INIS-BR—934, pp 164) **Preliminary results of a position sensitive X-ray detector.** Macchione, E.L.A.; Koide, K.; Dietzsch, O.; Bairrio Nuevo Junior, A.; Takai, H. (Sao Paulo Univ., Brazil. Inst. de Fisica; Rio de Janeiro Univ., Brazil). 1987. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701471/JAW. (CONF-8708216—).

From 10. workshop on nuclear physics in Brazil; Caxambu, MG, Brazil (26 Aug 1987).

22438 (INIS-BR—960) **Time of gamma radiation transport in NaI(Tl) scintillators.** Matarrita, A.S. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1976. 94p. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. Order Number TI88701614/JAW.

The distribution of time intervals in function of the energy, ocurred between the incidence of a gamma radiation in the face of a scintillation crystal and the arrival of the correspondent scintillation at photocathode, is calculated. The mean square fluctuation these time interval, relating to resolution of the detector system is determined. The calculations are done for NaI (Tl) cylindrical crystals with the radiation source placed in the symmetry axis, in two situations: para axial incidence and oblique incidence, indicating a good agreement with experimental data. (M.C.K.).

22439 (INIS-mf—10846, pp 10) **Comparison of some metrologic characteristics of dosemeters VA-J-15.A/2A and 27015.** Buchakliev, Z.; Penchev, V.; Ivanova, K. (Meditsinska Akademiya, Sofia, Bulgaria). Nov 1984. (In Bulgarian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

22440 (INIS-mf—10846, pp 12) **Dosimetric problems with the use of lead filters in radiotherapy with 43 MV bremsstrahlung.** Ganchev, M. (Nauchno-Izsledovatelski Onkologichen Institute, Sofia, Bulgaria). Nov 1984. (In Bulgarian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

22441 (INIS-mf—10846, pp 12) **Thermoluminescent detectors for fast neutrons.** Gelev, M.; Shopov, I.; Henniger, U.; Felinger, J. (Institute za Yadrena Izsledvaniya i Yadrena Energetika, Sofia, Bulgaria; Bylgarska Akademiya na Naukite, Sofia, Bulgaria; Joint Institute for Nuclear Research, Dubna, USSR; Technische Univ., Dresden, German Democratic Republic). Nov 1984. (In Bulgarian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

22442 (INIS-mf—10846, pp 13) **Photoelectric device for measurement of UV irradiation and doses from artificial UV sources (UVMD-1-83).** Georgiev, G. (Nauchno-Izsledovatelski Institute po Pochvoznanie, Sofia, Bulgaria). Nov 1984. (In Bulgarian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

22443 (INIS-mf—10846, pp 25) **New concept for the overall assessment of the quality of the dosimetric devices and methods.** Karadzhov, A. (Meditsinska Akademiya, Sofia, Bulgaria). Nov 1984. (In Bulgarian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

22444 (INIS-mf—10846, pp 25) **Thermoluminescence of some metal oxides and minerals and perspectives for their application in dosimetry.** Karadzhov, A. (Meditsinska Akademiya, Sofia, Bulgaria). Nov 1984. (In Bulgarian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

22445 (INIS-mf—10846, pp 31) **Investigation of dosimetric characteristics of radiophotoluminescent detectors.** Kirilova, R.; Kozhukharov, V.; Todorov, V.; Enikov, T. Nov 1984. (In Bulgarian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

22446 (INIS-mf—10846, pp 49) **Comparison of two personnel dosimetry and radiation monitoring methods.** Naumova, Ts. (Nauchno-Izsledovatelski Onkologichen Institute, Sofia, Bulgaria). Nov 1984. (In Bulgarian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

22447 (INIS-mf—10846, pp 4) **Beykovski's approach applied in gamma-spectrometric analysis of environmental samples.** Badulin, V. (Meditsinska Akademiya, Sofia, Bulgaria). Nov 1984. (In Bulgarian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

22448 (INIS-mf—10846, pp 7) **IMFRM-1 - an integral small size photoradiometer for measurement of UV and visible radiation from natural and artifical sources.** Bobev, K.; Karaganeva, R.; Stratieva, N.; Kabasanova, E.; Stoimenova, K. (Sofia Univ., Bulgaria; Bylgarska Akademiya na Naukite, Sofia, Bulgaria). Nov 1984. (In Bulgarian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

22449 (INIS-mf—10846, pp 7) **Bichannel photoradiometer.** Bobev, K.; Stratieva, N.; Kabasanova, E.; Bojchev, V.; Georgiev, P. (Bylgarska Akademiya na Naukite, Sofia). Nov 1984. (In Bulgarian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

22450 (INIS-mf—10846, pp 8) **Method and apparatus for determination of optical radiation efficiency in the UV and visible spectral regions.** Bobev, K.; Yanev, T.; Karaganeva, R.; Kabasanova, E.; Stratieva, N.; Stoimenova, K.; Mikhajlov, M.; Georgiev, P. (Sofia Univ., Bulgaria; Bylgarska Akademiya na Naukite, Sofia). Nov 1984. (In Bulgarian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

22451 (INIS-mf—10846, pp 10) **Specifities of X-rays measurements with the ionization chamber type 70127 (Robotron, DDR).** Buchakliev, Z. (Meditsinska Akademiya, Sofia, Bulgaria). Nov 1984. (In Bulgarian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

22452 (INIS-mf—10846, pp 19) **Comparison of the methods for determination of radon daughters specific activities and the potential energy of their alpha decay.** Dimitrov, M. (DSO Redki Metali, Bukhovo, Bulgaria). Nov 1984. (In Bulgarian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

22453 (INIS-mf—10846, pp 19) **Detection limit of low activities at small number of registrations.** Dimchev, T. (Vissh Minno-Geolozhki Institute, Sofia, Bulgaria). Nov 1984. (In Bulgarian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

22454 (INIS-mf—10846, pp 26) **Fast starting device for 150 Hz with thyristors.** Karadimov, D.; Petukhov, N.; Atanasov, I.; Dinev, R. (Meditsinska Akademiya, Sofia, Bulgaria). Nov 1984. (In Bulgarian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

22455 (INIS-mf—10846, pp 27) **Control circuit with logical elements for a wheeled X-ray generator.** Karadimov, D.; Petukhov, N.; Dinev, R. (Meditsinska Akademiya, Sofia, Bulgaria). Nov 1984. (In Bulgarian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

22456 (INIS-mf—10846, pp 27) **Turnover control circuit for X-ray tubes.** Karadimov, D.; Petukhov, N.; Dinev, R. (Meditsinska Akademiya, Sofia, Bulgaria). Nov 1984. (In Bulgarian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

22457 (INIS-mf—10846, pp 28) **Twelve-pulse X-ray generator with solid insulation.** Karadimov, D.; Petukhov, N.; Ilieva, R.; Rangelov, A. (Meditsinska Akademiya, Sofia, Bulgaria). Nov 1984. (In Bulgarian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

22458 (INIS-mf—10846, pp 28) **Compact bipulse X-ray generator with solid insulation.** Karadimov, D.; Petukhov, N.; Ilieva, R.; Rangelov, A. (Meditsinska Akademiya, Sofia, Bulgaria). Nov 1984. (In Bulgarian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

22459 (INIS-mf—10846, pp 30) **Analytical method for determination of detector systems spatial resolution.** Kerin, T.; Kyurkchiev, T.; Videnova, M. (Vissh Voenno-Meditsinski Institute, Sofia, Bulgaria). Nov 1984. (In Bulgarian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

22460 (INIS-mf—10846, pp 32) **Parameter assesment of the available machines for chemical treatment of X-ray films.** Kolev, D. (Meditsinska Akademiya, Sofia, Bulgaria). Nov 1984. (In Bulgarian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

22461 (INIS-mf—10846, pp 33) **Electronic circuit for functional control of X-ray film developing machine.** Kolev, D.; Karadimov, D. (Meditsinska Akademiya, Sofia, Bulgaria). Nov 1984. (In Bulgarian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

22462 (INIS-mf—11118) **Semiconductor beta ray spectrometer.** Bom, V.R. (Technische Univ. Delft (Netherlands)). 5 Feb 1987. 82p. NTIS (US Sales Only), PC A05/MF A01. Order Number TI88701753/JAW.

Includes summary in Dutch and previously published material.

Measurement of energy spectra of beta particles emitted from nuclei in beta-decay processes provides information concerning the mass difference of these nuclei between initial and final state. Moreover, experimental beta spectra yield information on the feeding of the levels in the daughter nucleus. Such data are valuable in the construction and checking of the level schemes. This thesis describes the design, construction, testing and usage of a detector for the accurate measurement of the mentioned spectra. In ch. 2 the design and construction of the beta spectrometer, which uses a hyper-pure germanium crystal for energy determination, is described. A simple wire chamber is used to discriminate beta particles from gamma radiation. Disadvantages arise from the large amounts of scattered beta particles deforming the continua. A method is described to minimize the scattering. In ch. 3 some theoretical aspects of data analysis are described and the results of Monte-Carlo simulations of the summation of annihilation radiation are compared with experiments. Ch. 4 comprises the results of the measurements of the beta decay energies of /sup 103-108/In. 87 refs.; 34 figs.; 7 tabs.

22463 (INIS-SU—442, pp 42-44) **Measuring total cross sections of neutron interaction with tellurium isotopes with on-line system based on the IVK-1.** Burmistrov, Yu.M.; Grigor'eva, T.E.; Molodtsov, Eh.D.; Musaelyan, R.M.; Potashev, S.I.; Skorkin, V.M. 1987. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88780052/JAW.

Kratkie soobshcheniya po fizike.; no. 4.

In Experimental and theoretical physics. Collection.

An on-line system for measuring total cross sections of neutron interactions with tellurium isotopes is developed on the basis of the SM-3 computer and CAMAC equipment. Neutron detection is exercised by a scintillation detector comprising a stilbene crystal. Neutron flux monitoring is realized by a long counter placed at the distance of 150 cm from the target at the angle of 45 deg to proton beam direction. A cylinder with channels of acrylic plastic is used for background radiation measuring. Internal channels and the forming surface of the cylinder are covered by boron carbide. Data acquisition, accumulation and processing are exercised by means of the SM-3 computer. The program for data accumulation is called at the beginning of operation; the characteristics of samples and other data necessary for realization of an experiment are displayed on the screen of the SM-3 computer. Total cross sections of neutron interactions with isotopes (A=122, 124, 126, 128, 130) and natural mixture of tellurium isotopes in the 0.2-1.1 MeV energy range with an error of 1-3% are obtaned by means of this system.

22464 (ITEF—9(1987)) **Software of the IVK-2 multicomputer complex with the Ehlectronica-60 central computer.** Verebryusov, V.S.; Kaspin, A.I.; Omel'yanova, E.B.; Sokolov, V.L.; Talinskij, V.M.; Sharova, E.L. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 21p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701104/JAW.

Two main components of JVK-2 multicomputer complex software for processing of PUOS-M and PTsS-M graphic information are described. Monitor program LOAD, maintaining interaction between the "Ehlektronica-60" central computer and local microcomputers, and PIOS control program, their general structure and functions are described. Structure of dialogue with operator, exit file format are presented. Information of LOAD program and control program test-diagnostic means are described. 2 refs.; 1 fig.

22465 (JINR—13-86-488) **Position-sensitive proportional detector with distributed delay circuit for magnetic spectrograph.** Tokmakov, A.V.; Vakhtel', V.M.; Chumin, V.G.; Brudanin, V.B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1986. 4p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87702967/JAW.

A detector of charged particles for a magnetic spectrograph is described. It contains 2 position-sensitive proportional counters placed in one volume one after another. The input-window dimensions are 500x10 mm. One-coordinate information readout is realized from one distributed delay line. The turn of the delay line serve simultaneousy as a cathode plane. Coordinate resolution is <2 mm for alpha particles. The counter proportional regime permits determination of the type of particles. The coincidence regime permits diminution of the background event registration. 6 references, 3 figures.

22466 (JINR—13-87-245) **Study of influence of gas mixture composition on the multistep avalanche chambers characteristics.** Abdushukurov, D.A.; Zanevskij, Yu.V.; Peshekhonov, V.D. (AN Tadzhikskoj SSR, Dushanbe. Fiziko-Tekhnicheskij Inst.; Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1987. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701653/JAW.

Submitted to the journal Instrum. Exp. Tech. .

The influence of the concentration of organic quenchers on the operation of multistep avalanche chambers /MSAC/ has been studied. An empirical dependence of the gas amplification factor of MSAC on the quencher concentration has been derived. Measures are considered to increase the stability of the MSAC operation. To improve the MSAC operation argon + n-heptane, neon + methane and neon + argon + methane mixtures are suggested. 16 refs.; 8 figs.; 2 tabs.

22467 (JINR—13-87-344) **Wide-aperture total absorption scintillation spectrometers of the SIGMA-AYAKS installation.** Antipov, Yu.M.; Budanov, N.P.; Gorin, Yu.P. and others. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1987. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701655/JAW.

Submitted to the journal Instrum. Exp. Tech. .

A wide-aperture total absorption scintillation spectrometers, one having a cylindrical geometry and two others - rectangular parallelepiped form are described. Total weight of spectrometer plastic scintillator is 1200 kg. Lightpipe- shifter bars are used for light collection. The results on methodical study of the spectrometers and the parameters obtained for recoil proton registration in real physical experiments on the Serpukhov accelerator are presented. The factor of nonuniformity of light collection does not exceed +-5%. The energy resolution is 6% for 200 MeV protons. 7 refs.; 7 figs.

22468 (JINR—R-7-86-322, pp 18) **Measurement of mass and energy distributions of /sup 256/Fm spontaneous fission fragments by polycarbonate detectors.** Sagajdak, R.N.; Tret'yakov, S.P. 1986. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780065/JAW.

In Heavy ion physics - 1985. Collection of annotations of the Nuclear Reaction Laboratory of the Joint Nuclear Research Institute works, 1985.

22469 (JINR—R-7-86-322, pp 52) **Double-arm time-of-flight spectrometers for the DEhMAS installation.** Zodan, Kh.; Luk'yanov, S.M.; Penionzhkevich, Yu.Eh. 1986. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780065/JAW.

In Heavy ion physics - 1985. Collection of annotations of the Nuclear Reaction Laboratory of the Joint Nuclear Research Institute works, 1985.

22470 (JINR—R-7-86-322, pp 53) **Installation for measuring mass of nuclei.** Belozerov, A.V.; Borcha, K; Dlougy, Z.; Kalinin, A.M.; Kalpakchieva, R.; Nguen Khoaj T'yau; Penionzhkevich, Yu.Eh.; Skobelev, N.K. 1986. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780065/JAW.

In Heavy ion physics - 1985. Collection of annotations of the Nuclear Reaction Laboratory of the Joint Nuclear Research Institute works, 1985.

22471 (JINR—R-7-86-322, pp 54) **Magnetic analyzer on the U-400 cyclotron beam.** Belozerov, A.B.; Skobelev, N.K.; Penionzhkevich, Yu.Eh.; Majdikov, V.Z.; Surovitskaya, N.T. 1986. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780065/JAW.

In Heavy ion physics - 1985. Collection of annotations of the Nuclear Reaction Laboratory of the Joint Nuclear Research Institute works, 1985.

22472 (JINR—R-7-86-322, pp 55) **Technique for measuring hard component of γ radiation in a heavy ion beam.** Kamanin, V.V.; Kugler, A.; Sobolev, Yu.G.; Eremin, N.V. 1986. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780065/JAW.

In Heavy ion physics - 1985. Collection of annotations of the Nuclear Reaction Laboratory of the Joint Nuclear Research Institute works, 1985.

22473 (JINR—R-7-86-322, pp 56) **Magnetic spectrometer-analyzer for studying interactions of heavy ions with MS-A installation.** Artyukh, A.G.; Volkov, V.V.; Gridnev, G.F.; Grushetski, M.; Karch, V.; Mezentsev, A.N.; Mikheev, V.L. 1986. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780065/JAW.

In Heavy ion physics - 1985. Collection of annotations of the Nuclear Reaction Laboratory of the Joint Nuclear Research Institute works, 1985.

22474 (JINR—R-7-86-322, pp 57) **On-line program-controlled multichannel measuring module of the MS-A installation.** Artyukh, A.G.; Smirnov, V.N.; Strekalovskij, O.V.; Chelnokov, L.P.; Lodojsamba, S. 1986. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780065/JAW.

In Heavy ion physics - 1985. Collection of annotations of the Nuclear Reaction Laboratory of the Joint Nuclear Research Institute works, 1985.

22475 (JINR—R-7-86-322, pp 59) **System for studying rare events of spontaneous fission in a heavy ion beam.** Chepigin, V.I.; Nad', Sh.; Abdullin, F.Sh.; Eremin, A.V.; Gorshkov, V.I.; Ter-Akop'yan, G.M. 1986. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780065/JAW.

In Heavy ion physics - 1985. Collection of annotations of the Nuclear Reaction Laboratory of the Joint Nuclear Research Institute works, 1985.

22476 (JINR—R-7-86-322, pp 62) **Determination of the parameters of the device for measuring nuclear momenta using laser radiation.** Gangrskij, Yu.P.; Marinova, K.P.; Markov, B.N.; Nadzhakov, E.G.; Khan Gen I; Chan Kong Tam. 1986. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780065/JAW.

In Heavy ion physics - 1985. Collection of annotations of the Nuclear Reaction Laboratory of the Joint Nuclear Research Institute works, 1985.

22477 (JINR—R-7-86-322, pp 64) **Multiwire dielectric detector.** Gasparyan, S.G.; Gukasyan, S.M.; Kavalov, R.L.; Luk'yanov, S.M.; Penionzhkevich, Yu.Eh.; Chubaryan, G.G. 1986. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780065/JAW.

In Heavy ion physics - 1985. Collection of annotations of the Nuclear Reaction Laboratory of the Joint Nuclear Research Institute works, 1985.

22478 (JINR—R-7-86-322, pp 63) **High-sensitivity crystal-diffraction X-ray spectrometer.** Altynov, V.A.; Artyukh, A.G. 1986. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780065/JAW.

In Heavy ion physics - 1985. Collection of annotations of the Nuclear Reaction Laboratory of the Joint Nuclear Research Institute works, 1985.

22479 (JINR—R-7-86-322, pp 65) **Detecting properties of polyvinylidenftoride (PVF).** Tret'yakova, S.P.; Shirkova, V.V.; Borcha, K.; Khitrova, N.B.; Dzholos, L.V. 1986. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780065/JAW.

In Heavy ion physics - 1985. Collection of annotations of the Nuclear Reaction Laboratory of the Joint Nuclear Research Institute works, 1985.

22480 (JINR—R-7-86-322, pp 66) **Studying the spectrometric peculiarities of high-ionizing particle detection by photoresistor detectors with SHF bias.** Borzunov, N.G.; Medvedev, Yu.V.; Mezentsev, A.N.; Petrov, A.S. 1986. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780065/JAW.

In Heavy ion physics - 1985. Collection of annotations of the Nuclear Reaction Laboratory of the Joint Nuclear Research Institute works, 1985.

22481 (JINR-R—6-86-536) **Procedure of beta-spectrogram processing and errors in the analysis of L structures of internal-conversion electrons.** Kononenko, G.A.; Kuznetsov, V.V.; Tsupko-Sitnikov, V.M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1986. 13p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87702984/JAW.

The automatic photometric-measuring device with pitch drives of the carriage on both axes operating on-line with a computer is described. It is intended for processing β spectrograms from magnetic spectrographs. Errors in determining the relative intensities of conversion electrons due to the properties of photoemulsions used for spectrum detection, β spectrogram properties and characteristics of β spectrograms as well as the device used are considered. The procedure of internal conversion electron (ICE) spectrum processing is discribed. For mathematical processing of the spectra, the UPEAK program is used which applies the table task of the model line. The conclusion is drawn that the relations of ICE L-, M-line intensities could be obtained from the beta spectrograms using this equipment and the elaborated procedure of processing with 5x10% error. 18 references, 7 figures

22482 (JINR-R—10-86-528) **On-line program for measuring images from bubble chambers using HPD and SHP special processor.** Baginyan, S.A.; Govorun, N.N.; Lugovtsova, V.R.; Shigaev, V.N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1986. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87702989/JAW.

The CDC-1604A on-line program for measuring bubble-chamber pictures using HPD flying spot digitizer and SHP special hardware processor at minimum guidance (vertex guidance) is briefly described. 8 references, 1 figure.

22483 **(JINR-R—10-86-562) Digital filter unit for selection of spectrometric information.** Vagov, V.A.; Novozhilov, V.E.; Sirotin, A.P.; Shibaev, V.D. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1986. 5p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87702990/JAW.

The digital-filter unit is intended for preliminary selection of spectrometric information. Static semiconductor storage devices K537RU2A are used as digital filters. One unit consists of three digital filters. Their parameters are given by a computer program. The switching function of each digital filter is also realized by a computer program. The unit performs in the CAMAC standard. The developed program permits using these digital-filter units as a unit of a wide employment in most measurement modules without any modification of their soft- and hardwares. 10 references, 1 figure.

22484 **(JINR-R—10-86-574) Modular system for spectrometric data acquisition. General description.** Boja, J.; Vagov, V.A.; Zhukov, G.P.; Rubin, D.; Harangozo, Zs. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1986. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87702991/JAW.

A modular system for multi-dimensional measurement in the field of nuclear physics is developed. It is realised on the base of the CAMAC standard using a new external auxiliary data acquisition bus. A set of modules has been developed: Input Module, FIFO and Multi-Channel Analyser. With the help of these modules data acquisition systems for different multi-dimensional experiments were configured. 4 references, 7 figures.

22485 **(JINR-R—10-86-609) Frame number decoding in real-time filter system on HPD.** Belyaev, A.V.; Simonova, N.G.; Slepnev, S.K.; Susov, Yu.I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1986. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87702992/JAW.

While measuring films on HPD, it is necessary to find and decode the data-box information and particularly, the frame number quickly and reliably. The method described is used in the real-time filter system on HPD. It takes 40-250 ms of processor time, which is equivalent to 1-6 mm frame length and provides finding and decoding the frame number, thus allowing the information from the first pair of fiducials to be processed in proper time. 4 references, 3 figures.

22486 **(JINR-R—10-86-610) Method of search for fiducials in real-time filter system on HPD.** Belyaev, A.V.; Simonova, N.G.; Slepnev, S.K.; Susov, Yu.I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1986. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87702993/JAW.

The method is based on the well-known histogramming techniques. Nevertheless, by means of some special tricks, the authors managed to reduce the time for processing a pair of fiducials down to 40-200 ms on the CDC-1604A computer, making the rest of the processor time free for filtering the information from tracks. 6 references, 4 figures, 1 table.

22487 **(JINR-R—10-86-611) System for modelling experiments with hybrid spectrometer.** Abdurakhimov, A.U.; Govorun, N.N.; Goman, V.S.; Ivanov, V.G.; Okhrimenko, L.S.; Saitov, I.S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1986. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87702994/JAW.

A system for modelling chamber experiments with a GIBS set-up is described. The system was created on base of the HYDRA and FOWL program system modules. It was tested in studying p-d interactions. More than 300 events have been processed. 9 references, 1 figure, 4 tables.

22488 **(JINR-R—10-86-612) Automated system for mathematical processing of the data from a hybrid spectrometer.** Abdurakhimov, A.U.; Balgasuren, Ya.; Buzdavina, N.A.; Govorun, N.N.; Goman, V.S.; Ivanov, V.G.; Matyushin, A.T.; Okhrimenko, L.S.; Saitov, I.S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1986. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87702995/JAW.

An automated system for hybrid spectrometer data mathematical processing is described. The system provides for automatic processing by chains of programs and preliminary analysis of computer results. The system operation was tested in modelling the p-d events. 8 references, 1 figure.

22489 **(JINR-R—10-86-613) HPD stage and film-gate-control algorithms.** Belyaev, A.V.; Simonova, N.G.; Slepnev, S.K.; Susov, Yu.I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1986. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87702996/JAW.

Algorithms used for stage and film-gate control on HPD are described. The stage-control algorithm drives the HPD stage to target position in less than 3 seconds with 25-micron accuracy. The film-gate-control algorithm provide for 0.3- to 0.6-mm accuracy in frame positioning within the film gate, and gives the opportunity to determine the data box position with approximately 60-micron precision in the direction along the film. 4 references, 3 figures, 1 table.

22490 **(JINR-R—10-86-623) Results of comparative analysis of measurements on a spiral reader of events from the RISK spectrometer.** Kalmykova, L.P.; Kotov, V.M.; Moroz, V.I.; Selivanov, A.E.; Shelkov, G.A.; Yamburenko, V.S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1986. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87702997/JAW.

A check-measurement series was performed in order to determine spiral reader (SR) precision and efficiency for selecting tracks from the RISK spectrometer stereofilms. The comparative analysis of SR and semi-automatic image processing device (SAIPI) data showed that the SR characteristics satisfy the requirements for the measurement systems of streamer chamber film processing. The efficiency of SR data processing is similar to that of SAIPD but the accuracy and productivity of SR are by a factor of 1.5 greater. 11 references, 3 figures, 1 table.

22491 **(JINR-R—10-86-624) Organization of communication between a spiral reader and ES computer.** Belyaev, A.V.; Bondarenko, O.N.; Kazakov, A.A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1986. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87702998/JAW.

Organization of the communication channel between the spiral reader (SR) and an ES computer for measurement-data transmission is described. The implementation of the channel is based on EC-7920 local terminal system and its small interface. The ES-7920 connection with SR for data transfer and reception is made using CAMAC crate bus. Exchange programs work at the TPA/i small computer was included in SR. A real-time program using an RTS standard ES real-time supervisor controls the data transmission between the ES-7922 local group control unit and ES computer. 6 references, 1 table.

22492 **(JINR-R—10-87-275) Electronic equipment and software of the mesooptical Fourier - transform microscope for nuclear emulsion.** Astakhov, A.Ya.; Bentse, D.; Veg, Ya.; Kishvaradi, A.; Nitrai, G.; Soroko, L.M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems; Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1987. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701672/JAW.

The electronic part of the Mesooptical Fourier-Transform Microscope (MFTM) and the software for the automatic recording of the straight line particle tracks of minimum ionization in nuclear emulsion are described. The features of the data at the output of the MFTM depending on the geometrical position of a straight line particle track and the algorithm of the read-out of this data are given. The units moving the carriages and rotating the platform of the optical interface of the MFTM are described. The programming supplements to the standard FOKAL'71 subroutines used in these experiments as well as the routine programme used for the evaluation of the mesooptical images of straight line particle tracks are presented. 11 refs.; 2 figs.

22493 **(JINR-R—11-87-273) System of experiment condition control for the KDSOG-M spectrometer.** Bran'kovski, J.; Elizarov, O.I.; Ivan'ski, V.; Natkanets, I.; Vajdkhadze, F.; Zaleski, T.; Oleyarchik, V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics; Technische Univ., Dresden (German Democratic Republic); Institute of Nuclear Physics, Krakow (Poland)). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1987. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701675/JAW.

The remote control system for the experiment set-ups of the KDSOG-M neutron spectrometer (angular positions, temperature, pressure) is described. The system provides the measurement of up to 32 analog signals and operates along with the remotely controlled time-of-flight analyser. The system, confined to the CAMAC standard, runs on a minicomputer linked with the microprocessor crate controller. 4 refs.; 2 figs.

22494 **(JINR-R—13-86-563) Estimation of resistive-cathode transparency.** Barabash, L.S.; Mecaross, L.; Chalyshev, V.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Dept. of New Acceleration Methods). 1986. 5p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703000/JAW.

Estimates of resistive-surface-coating transparency used in plastic drift tubes as cathodes are presented. Losses in the charge amplitude, detected by a system of external electrodes, due to the skin effect become significant for surface resistances of about 1Ω/square. The value of surface resistance is limited by charge diffusion. The calculated dependences of the charge distribution induced on the cathode are presented. From this, it follows that surface resistances of the order of 10^3Ω/square can be used. 6 references, 3 figures.

22495 **(JINR-R—13-86-588) Electronic system for registration of rare nuclear transformations by detecting multiple neutron events.** Smirnov, V.I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1986. 13p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703001/JAW.

An electronic system intended for registration of rare events of spontaneous fission by detecting multiple neutron emission is described. The system is performed in the COMPEX-CAMAC standard. The neutron detector includes 90 ^{3}He counters and is situated in a room with passive concrete shielding equivalent to a water layer about 15 m thick. The system controls a fission source and the parameters of active cosmic-radiation protection, which includes 10 plastic scintillators with 70 photomultipliers. 18 references, 10 figures.

22496 **(JINR-R—13-86-630) Observation of relativistic proton tracks by means of meso-optical Fourier microscope for nuclear emulsion.** Bencze, Gy.L.; Kisvaradi, A.; Nitraj, G.; Soroko, L.M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1986. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703002/JAW.

Experiments on quality control of a meso-optical mirror made of metal by precision diamand turning are described. It is shown experimentally that the width of the meso-optical ring produced by this mirror for the point light source is equal to 1.5 μm. Experiments to obtain meso-optical images and signals from tracks of relativistic protons giving minimal ionization in the nuclear emulsion by means of mesooptical Fourier microscope are described. 7 references, 10 figures.

22497 **(JINR-R—13-86-659) Geometrical and optical performances of the meso-optical Fourier-transformation microscope in the meridional cross section.** Bencze, Gy.L.; Soroko, L.M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1986. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703003/JAW.

An analysis of the geometrical and optical performances of the meso-optical fourier-transformation microscope (MFTM) for nuclear emulsion is given. The analysis is carried out for the meridional cross section of MFTM without optical substrate, with spherical immersion substrate, plane immersion substrate and an immersion condenser. The light-intensity distribution in the region of the meso-optical images of a straight-line particle track in nuclear emulsion is found. It is shown that the geometrical aberrations in the meridional cross section of the MFTM does not permit to reduce the diameter of the meso-optical mirror below 150-200 mm in the case of the given optical construction, and that the effects induced by geometrical and optical aberrations in the MFTM must be taken into consideration during processing the meso-optical signals formed at the MFTM output. 12 references, 15 figures.

22498 **(JINR-R—13-87-144) Method for continuous registration of linear spectrometric circuit alive time.** Bechvarzh, F.; Telezhnikov, S.A.; Tishin, V.G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1987. 4p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701677/JAW.

A method for continuous registration of the alive time of linear spectrometric circuit in regime of pulse counting is developed for measuring gamma spectra in neutron resonances. The neutron energy in these measurements is determined by the time-of-flight method. The alive time of the circuit is registrated by means of pulses of a periodic generator with stable amplitude which receive an additional status bit in ADC. The information on amplitude of the detector pulse and on time of flight of each event is recorded on the magnetic tape. The time of flight spectrum of generator pulses is obtained when scanning information by additional status bit. The analysis of this spectrum permits to introduce corrections on the alive time of spectrometric circuit. 3 refs.; 2 figs.

22499 **(JINR-R—13-87-188) Special modules of multidetector spectrometers for nuclear reaction products.** Kuznetsov, A.N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1987. 13p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701678/JAW.

A growth of information and an increasing volume of apparatus lead to the necessity to improve the structure of measuring systems. In multichannel installations the multiplexing of signals is used for this purpose. In the multiparameter systems characterized by a high intensity of background events it is important to perform measurements with a minimum deadtime due to the background. The methods mentioned above are applied using the special electronic modules - analogue multiplexers and units for the organization of multiparameter spectrometric measurements. The latest modifications of these modules are described along with functional circuits, the most important parts of the electrical circuits and specifications. Some particularities of the application of the methods are also given. 10 refs.; 11 figs.

22500 **(KIYI—86-55) Responce function of absolute ionization chamber in the presence of an absorber in γ-beam.** Bigan, Z.M.; Mazur, V.M.; Sokolyuk, I.V. (AN Ukrainskoj SSR, Kiev. Inst. Yadernykh Issledovanij). 1986. 14p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701687/JAW.

The calculation is made for energy ranges of 1-30 MeV of the response function F(E/sub γM/) of absolute aluminium thick-layered ionization chamber with front wall thickness equal to 7.5 cm taking account of absorbers in bremsstrahlung gamma-beam made of beryllium, aluminium with different thickness 9.2, 18.4 and

13.55, 27 g/cm/sup 2/ correspondently and of graphite with a thickness of 8.4, 11.76 and 16.8 g/cm/sup 2/ so as without absorbers. A correctness of estimates is made by studying on the bremsstrahlung beam the reaction /sup 63/Cu(γ, n)/sup 62/Cu. 13 refs.; 4 figs.; 2 tabs.

22501 **(N—88-13556) Study of solid state photomultiplier. Final contractor report, 1 June 1986-30 April 1987.** Hays, K.M.; Laviolette, R.A. (Rockwell International Corp., Anaheim, CA (USA)). Aug 1987. 55p. (NASA-CR—177465; NAS—1.26:177465). NTIS, PC A04/MF A01.

Available solid state photomultiplier (SSPM) detectors were tested under low-background, low temperature conditions to determine the conditions producing optimal sensitivity in a space-based astronomy system such as a liquid cooled helium telescope in orbit. Detector temperatures varied between 6 and 9 K, with background flux ranging from 10 to the 13th power to less than 10 to the 6th power photons/square cm-s. Measured parameters included quantum efficiency, noise, dark current, and spectral response. Experimental data were reduced, analyzed, and combined with existing data to build the SSPM data base included herein. The results were compared to analytical models of SSPM performance where appropriate models existed. Analytical models presented here were developed to be as consistent with the data base as practicable. Significant differences between the theory and data are described. Some models were developed or updated as a result of this study.

22502 **(N—88-14049) Photon counting image sensor development for astronomical applications. Final project report, 1 July 1979-14 September 1987.** Jenkins, E.B. (Princeton Univ., NJ (USA). Observatory). Nov 1987. 61p. (NASA-CR—181507; NAS—1.26:181507). NTIS, PC A04/MF A01.

Specially built intensified CCD (ICCD) detector tubes were purchased and the performance of the electron bombardment process was investigated. In addition to studying the signal characteristics of the photoevents, there was interest in demonstrating that back-illuminated chips were not susceptible to radiation damage to their clocking electrodes. How to perform a centroid analysis for a 2-dimensional Gaussian distribution of charge is described. Measurement of the projection (along columns or rows) of the average charge spread profile is discussed. The development and flight of the Interstellar Medium Absorption Profile Spectrograph (IMAPS) is discussed.

22503 **(NIKHEF-H—87-7) High resolution spaghetti hadron calorimeter. Proposal.** Jenni, P.; Sonderegger, P.; Paar, H.P.; Wigmans, R. (European Organization for Nuclear Research, Geneva (Switzerland); Nationaal Inst. voor Kernfysica en Hoge-Energiefysica (NIKHEF), Amsterdam (Netherlands). Sectie H). (Nationaal Inst. voor Kernfysica en Hoge-Energiefysica (NIKHEF), Amsterdam (Netherlands). Sectie H). 27 Apr 1987. 27p. NTIS (US Sales Only), PC A03/MF A01. Order Number TI88701772/JAW.

It is proposed to build a prototype for a hadron calorimeter with scintillating plastic fibres as active material. The absorber material is lead. Provided that these components are used in the appropriate volume ratio, excellent performance may be expected, e.g. an energy resolution of 30%/$\sqrt{E}$ for jet detection. The proposed design offers additional advantages compared to the classical sandwich calorimeter structures in terms of granularity, hermiticity, uniformity, compactness, readout, radiation resistivity, stability and calibration. 22 refs.; 7 figs.

22504 **(NUCLEBRAS-CDTN—547) Proposal and verification of digital densitometer-microcomputer interface for data collection.** Muniz, F.J.; Lorenzoni, L.F. (Centro de Desenvolvimento da Tecnologia Nuclear, Belo Horizonte (Brazil)). 1986. 10p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701701/JAW.

This work presents the development of an interface, which improves the entrance process in a computerized data system for radiological control. This device connects automatically a digital densitometer, allowing the data storage for further processing. Its main advantages are the following: (a) the efficiency of the system is increased, due to the smaller interference of accidental errors; (b) lower time and cost by processed dosimetric film. This system has been running for about six months and processes about three thousand dosimetric films monthly. (Autor).

22505 **(PITHA—87-07) Influence of a magnetic field on the drift of electrons in CO/sub 2/-IsoC/sub 4/H/sub 10/ mixtures.** Gessner, U. (Technische Hochschule Aachen (Germany, F.R.). Lehrstuhl fuer Experimentalphysik 3B und 3. Physikalisches Inst.). May 1987. 60p. (In German). Technische Hochschule Aachen (Germany, F.R.). Lehrstuhl fuer Experimentalphysik 3B und 3. Physikalisches Inst. .

A drift chamber with rectangular drift cells was constructed which represents an original section of a sector of a high-resolution vertex chamber. As gas mixture CO/sub 2/-isoC/sub 4/H/sub 10/ was used in the ratio 80%-20% which is marked by low drift velocity and low diffusion. It is therefore especially well suited for the application in high-resolution drift chambers. Furthermore in this gas the influence of a magnetic field on the drift of the electrons is very small. With the applied drift chamber (within the measurement accuracy) no differences between the space-drift time relations at magnetic fields of 0, 0.5, and 1 tesla were observed. The reached spatial resolutions ly in the medium drift range of the cells at 40 μm for normal pressure and below 30 μm for 2 bar absolute. These values are in agreement with the values of the sector mentioned above. In the magnetic field no deterioration of the spatial-resolution values was observed. CO/sub 2/-isoC/sub 4/H/sub 10/ mixtures are therefore for the application in magnetic fields especially well suited because in them the change of the electron drift is only minimal in comparison to otherwise usual gases. The absolute accuracy of the space-drift time relation extends to +-200 μm. This takes effect on the curves of the spatial resolution (discontinuities). The track definition from the chamber data alone is not so successful as in the sector mentioned above because too few drift cells are available. A more accurate measurement of the effects in magnetic fields is only with a larger chamber with essentially drift cells possible. The magnet which was available for the experiment however allowed no increasement of the chamber dimensions. (orig./HSI).

22506 **(UND-HEP—87-DP01) A new scintillating glass for high energy physics applications.** Puseljic, D.; Baumbaugh, B.; Bishop, J.; Busenitz, J.; Cason, N.; Cunningham, J.; Gardner, R.; Kennedy, C.; Mannel, E.; Mountain, R.J. (Notre Dame Univ., IN (USA). Dept. of Physics; Fermi National Accelerator Lab., Batavia, IL (USA); Synergistic Detector Designs, Mountain View, CA (USA); Levy-Hill Lab., Cheshunt, Waltham (UK)). Oct 1987. Contract AC03-84ER80146;AC02-76CH03000. 3p. (CONF-871006—47). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88006013/JAW.

From Nuclear science symposium; San Francisco, CA, USA (21 Oct 1987).

A new scintillating glass has been developed containing Cerium (3+) oxide in an aluminate host glass. In this material the scintillation emission spectrum is red-shifted relative to that observed for Ce^{3+} in silicate glasses. Additionally emission and absorption spectra are more widely separated in the aluminate composition, suggesting that such glasses might have improved light transmission properties. The refractive index is high, making it a potentially interesting material for use in fiber-optic tracking detectors.

22507 **Spin sensitivity of a channel electron multiplier.** Scholten, R.E.; McClelland, J.J.; Kelley, M.H.; Celotta, R.J. (Radiation Physics Division, National Bureau of Standards, Gaithersburg, Maryland 20899). *Review of Scientific Instruments;* **59**: No. 3, 506-508(Mar 1988).

We report direct measurements of the sensitivity of a channel electron multiplier to electrons with different spin orientations. Four regions of the multiplier cone were examined using polarized electrons at 100-eV incident energy. Pulse counting and analog modes of operation were both investigated and in each case the observed spin effects were less than 0.5%.

22508 Proposed recoil mass spectrometer for heavy ion reactions. Cole, J.D.; Cormier, T.M.; Hamilton, J.H.; Ramayya, A.V. (INEL, P.O. Box 1625, Idaho Falls, ID 83401). *AIP (American Institute of Physics) Conference Proceedings;* **164**: No. 1, 835-838(10 Dec 1987). (CONF-870970—).

From 5. international conference on nuclei far from stability; Lake Rosseau, Canada (14 Sep 1987).

A proposed recoil mass spectrometer of high rigidity, large solid angle acceptance, and good mass resolution for use with the HHIRF accelerators at ORNL is described.

22509 Tests of a large air-core superconducting solenoid as a nuclear-reaction-product spectrometer. Stern, R.L.; Becchetti, F.D.; Casey, T.; Jaenecke, J.W.; Lister, P.M.; Liu, W.Z.; Kovar, D.G.; Janssens, R.V.F.; Vineyard, M.F.; Phillips, W.R.; and others. (University of Michigan, Ann Arbor, MI 48109). *AIP (American Institute of Physics) Conference Proceedings;* **164**: No. 1, 845-848(10 Dec 1987). (CONF-870970—).

From 5. international conference on nuclei far from stability; Lake Rosseau, Canada (14 Sep 1987).

An air-core superconducting solenoid, with a diameter of 0.2 m and a length of 0.4 m, has been configured for use as a heavy-ion reaction-product spectrometer ($E/A \leqq 5$ MeV/u) near $\theta = 0°$ (10 to 35 msr). The performance of the spectrometer was established using α-particle sources and nuclear-reaction products from (^{18}O, ^{18}Ne), (^{18}O, ^{20}Ne) and (^{18}O, ^{14}O) and masses determined for ^{30}Mg, /sup 108/Ru and /sup 109/Rh. A system suitable for production of radioactive beams has been constructed, and in-beam tests are in progress at the University of Notre Dame. Large air-core solenoids with $d\Omega \leqq 20$ msr and capable of focusing ions with $E/A \geqq 30$ MeV/u appear feasible.

22510 Unisor on-line nuclear orientation facility. Girit, I.C.; Alton, G.D.; Bingham, C.R.; Carter, H.K.; Simpson, M.L.; Cole, J.D.; Hamilton, J.H.; Kern, B.D.; Krane, K.S.; Zganjar, E.F.; and others. (Vanderbilt University, Nashville, TN 37235 and Joint Institute for Heavy-Ion Research, Oak Ridge, TN 37830). *AIP (American Institute of Physics) Conference Proceedings;* **164**: No. 1, 849-852(10 Dec 1987). (CONF-870970—).

From 5. international conference on nuclei far from stability; Lake Rosseau, Canada (14 Sep 1987).

The UNISOR on-line nuclear orientation facility consists of a He_3—He_4 dilution refrigerator on line to the isotope separator. Nuclei are implanted directly onto a target foil soldered to the bottom accessed cold finger of the refrigerator. A 1.5 T superconducting magnet polarizes the ferromagnetic target foils and determines the axis of symmetry. Up to eight gamma detectors can be positioned around the refrigerator, each 9 cm from the target. A unique feature of this system is that the $k = 4$ term in the directional distribution function can be deduced so that a single solution for the mixing ratio can be found.

22511 Sudbury Neutrino Observatory. Ewan, G.T.; SNO Collaboration. (Queen's University, Kingston, Ontario K7L 3N6). *AIP (American Institute of Physics) Conference Proceedings;* **164**: No. 1, 585-592(10 Dec 1987). (CONF-870970—).

From 5. international conference on nuclei far from stability; Lake Rosseau, Canada (14 Sep 1987).

A description is given of the proposed Sudbury Neutrino Observatory based on a 1000 tonne heavy water Cherenkov detector which is being designed. This detector would allow the measurement of neutrinos by the three reactions ν/sub e/d → ppe, ν/sub x/e → ν/sub x/e and ν/sub x/d → ν/sub x/pn (where ν/sub x/ is any left-handed neutrino). The application of the detector to the resolution of the solar neutrino problem is discussed.

22512 Early expectations of AMS: Greater ages and tiny fractions. One Failure? - One success. Schmidt, F.H.; Balsley, D.R.; Leach, D.D. (Washington Univ., Seattle, USA. Nuclear Physics Lab.). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **29**: No. 1/2, 97-99(Nov 1987). (CONF-8704112—).

From 4. international symposium on accelerator mass spectrometry; Ontario, Canada (27 Apr 1987).

Two of the early expectations of AMS were extension to greater /sup 14/C ages than possible with beta counting, and applications using tiny amounts of carbon. We examine each in the light of our experiences. The age limit depends on true or apparent ion counts, which may originate in sample preparation, in the accelerating system itself, or from ions other than /sup 14/C which are not adequately suppressed. /sup 14/N ions are generated spontaneously in our FN tandem, whether the ion source is open to the tandem or not, but are suppressed in the detector. There is no evidence of spontaneous /sup 14/C ion production. Thus, the ion-source and tandem system alone is capable of age determinations ≧ 90 000 yr. For presumably 'dead' geological graphite, we obtain a maximum of 70 000 yr, and about 50 000 yr for 'dead' material which has undergone chemical and physical preparation. In this respect our full AMS system is at present a mixed success. However, our applications to small fractions have been quite successful. We have applied this advantage to the study of the organic carbon components present in the Amazon River and in deep sea cores.

22513 Status of the Berkeley small cyclotron AMS project. Bertsche, K.J.; Friedman, P.G.; Morris, D.E.; Muller, R.A.; Welch, J.J. (Lawrence Berkeley Lab., CA, USA). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **29**: No. 1/2, 105-109(Nov 1987). (CONF-8704112—). Contract AC03-76SF00098.

From 4. international symposium on accelerator mass spectrometry; Ontario, Canada (27 Apr 1987).

A small, low-energy cyclotron ('cyclotrino') has been designed and built at Berkely for direct detection dating of /sup 14/C. The system combines the use of a negative ion source to reject /sup 14/N with the high resolution of a cyclotron to reject other background ions. In order to allow the dating of old and small samples, the present system incorporates a high-current external ion source and injection beamline. The system is expected to be operational by mid-1988.

22514 Determination of Os isotopes and Re/Os ratios using AMS. Teng, R.T.D.; Fehn, U.; Elmore, D.; Hemmick, T.K.; Kubik, P.W.; Gove, H.E. (Rochester Univ., NY, USA. Dept. of Geological Sciences; Rochester Univ., NY, USA. Nuclear Structure Research Lab.; Argonne National Lab., IL, USA. Environmental Research Div.). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **29**: No. 1/2, 281-285(Nov 1987). (CONF-8704112—). Contract W-31-109-ENG-38.

From 4. international symposium on accelerator mass spectrometry; Ontario, Canada (27 Apr 1987).

We report here results of recent determinations of osmium isotope ratios and rhenium/osmium ratios measured with AMS. Because Re forms negative atomic ions with a considerably lower efficiency than Os, Os isotopes can be determined with minimal isobaric interference at mass 187. Detection limits for AMS measurements of osmium are 20 ppb in chemically untreated samples and 0.01 ppb in samples where Os has been preconcentrated with a nickel sulfide method. The fact that Re and Os each form negative ions as oxides at a comparable rate has been used to determine Re/Os ratios in untreated meteorite samples.

22515 Applications of /sup 129/I and /sup 36/Cl in hydrology. Fabryka-Martin, J.; Davis, S.N.; Elmore, D. (Arizona Univ., Tucson, USA. Dept. of Hydrology and Water Resources; Argonne National Lab., IL, USA. Environmental Research Div.). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **29**: No. 1/2, 361-371(Nov 1987). (CONF-8704112—). Contract W-31-109-ENG-38.

From 4. international symposium on accelerator mass spectrometry; Ontario, Canada (27 Apr 1987).

Since the first AMS measurements of /sup 36/Cl in 1978, this cosmogenic radionuclide has proved to be a versatile tracer of hydrologic processes in over 20 field studies. Natural /sup 129/I also appears to be useful for studying hydrologic processes al-

though incomplete understanding of its production in nature and geochemical behavior largely limits interpretation to qualitative discussions. The range of hydrologic applications demonstrated for these radionuclides covers: estimation of residence time of water in the subsurface and net infiltration in arid soils; evaluation of ion filtration, leaching of connate water, and salt dissolution as sources of ground-water salinity; estimation of lithospheric thermal-neutron fluxes; and emanation and migration characteristics of fission-product /sup 129/I in different geochemical environments.

22516 **Infiltration at Yucca Mountain, Nevada, traced by /sup 36/Cl.** Norris, A.E.; Wolfsberg, K.; Gifford, S.K.; Bentley, H.W.; Elmore, D. (Los Alamos National Lab., NM, USA; Hydro Geo Chem., Inc., Tucson, AZ, USA; Rochester Univ., NY, USA. Nuclear Structure Research Lab.). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **29**: No. 1/2, 376-379(Nov 1987). (CONF-8704112—).

From 4. international symposium on accelerator mass spectrometry; Ontario, Canada (27 Apr 1987).

Measurements of chloride and /sup 36/Cl in soils from two locations near Yucca Mountain, Nevada, have been used to trace the infiltration of precipitation in this arid region. The results show that the /sup 36/Cl fallout from nuclear-weapons testing formed a well-defined peak at one location, with a maximum /sup 36/Cl/Cl ratio 0.5 m below the surface. The structure of the /sup 36/Cl bomb pulse at the other location was much more complex, and the quantity of /sup 36/Cl in the bomb pulse was < 1% of the 6 x 10/ sup 12/ atoms /sup 36/Cl/m/sup 2/ in the bomb pulse at the first location. The data indicate hydrologic activity subsequent to the / sup 36/Cl bomb-pulse fallout at one location, but none at the other location.

22517 **Determination of /sup 129/I in heavy residues of two crude oils.** Fehn, U.; Teng, R.T.D.; Tullai, S.; Elmore, D.; Kubik, P.W. (Rochester Univ., NY, USA. Dept. of Geological Sciences; Rochester Univ., NY, USA. Nuclear Structure Research Lab.; Argonne National Lab., IL, USA. Environmental Research Div.). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **29**: No. 1/2, 380-382(Nov 1987). (CONF-8704112—). Contract W-31-109-ENG-38.

From 4. international symposium on accelerator mass spectrometry; Ontario, Canada (27 Apr 1987).

/sup 129/I//sup 127/I ratios were determined in heavy residues of two crude oils which were produced from 10 Ma and 300 Ma old formations. The measured /sup 129/I//sup 127/I ratios were between 5 and 10 x 10/sup -12/. These values are significantly above the ratios determined for marine sediments and, for the older oil, also above those supported by in situ production of /sup 129/I from uranium. We attribute the high level of /sup 129/I in the residues to addition of anthropogenic iodine during the production of the oils. The ratios indicate also that more than 90% of the iodine measured came originally from the oils.

22518 **Are AMS /sup 7/Be measurements for a lithium solar neutrino detector practical?.** Fireman, E.L.; Litherland, A.E.; Rowley, J.K. (Smithsonian Astrophysical Observatory, Cambridge, MA, USA; Toronto Univ., Ontario, Canada. Isotrace Lab.; Brookhaven National Lab., Upton, NY, USA. Dept. of Chemistry). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **29**: No. 1/2, 387-388(Nov 1987). (CONF-8704112—).

From 4. international symposium on accelerator mass spectrometry; Ontario, Canada (27 Apr 1987).

An efficient, low-background method of measuring /sup 7/Be is necessary to make a solar neutrino detector using lithium practical. Accelerator mass spectrometric /sup 7/Be measurements with BeO sputter sources are inefficient because of the small molecule (atom) to ion conversion. By collecting the sputtered BeO, that has not been accelerated, on an aluminum electrode and preparing additional sources from the collected Be, the overall efficiency might be raised sufficiently so that a lithium solar neutrino detector would be practical.

22519 **Variable pressure ion chamber for relative and absolute flux measurement.** Yang, B.X.; Kirz, J.; McNulty, I. (Dept. of Physics, SUNY at Stony Brook, NY 11794). pp 34-39 of X-ray calibration: Techniques, sources and detectors. Rockett, P.D.; Lee, P. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1986). (CONF-860880—).

From 30. SPIE technical symposium on optics and optoelectronic engineering; San Diego, CA, USA (17 Aug 1986).

When an X-ray beam is not monochromatic, the transmitted flux through an absorber is not an exponential function of the absorber thickness. Instead, it may be a sum of two, or three, or more exponential functions depending on whether the beam contains photons of two, three, or more different energies. This work shows that if the thickness of a gaseous absorber is continuously varied by adjusting the gas pressure, the relative strength of different harmonics in the monochromator output can be determined. This method also provides an accurate means to measure the absolute cross section of the gas molecules, and in conjunction with a modified Samson type ion chamber may also be used to measure the absolute photon flux as well.

22520 **Characterization of the absolute photon sensitivity of gold cathode photoelectric detectors.** Dozier, C.M.; Freitag, R.K.; Fehl, D.L. (Naval Research Lab., Washington, DC 20375-5000). pp 87-92 of X-ray calibration: Techniques, sources and detectors. Rockett, P.D.; Lee, P. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1986). (CONF-860880—).

From 30. SPIE technical symposium on optics and optoelectronic engineering; San Diego, CA, USA (17 Aug 1986).

The responses of gold cathode photoelectric detectors to photons in the 3 to 7.5 keV energy band have been measured using synchrotron radiation. The photoelectron detectors under study have cathodes with a conical configurations. Their sensitivities with respect to position on the cathode are nearly uniform (within 30 percent) over approximately 65 percent of the cone surface. The responses fall rapidly near the outer edges. Sensitivities with respect to the photon angle of incidence are proportional to (sin θ)/sup -1/. In the photon energy band covered, the measured response of the detectors are approximately 20 percent lower than the responses measured with conventional x-ray sources. These differences are due to differences in the geometries of the two calibrations.

22521 **Techniques of absolute low energy x-ray calibration.** Day, R.H. (Physics Div., Los Alamos National Lab., P.O. Box 1663, Mail Stop D410, Los Alamos, NM 87545). pp 94-101 of X-ray calibration: Techniques, sources and detectors. Rockett, P.D.; Lee, P. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1986). (CONF-860880—).

From 30. SPIE technical symposium on optics and optoelectronic engineering; San Diego, CA, USA (17 Aug 1986).

Recent advances in pulsed plasma research, materials, science, and astrophysics have required many new diagnostic instruments for use in the low energy x-ray regime. The characterization of these instruments has provided a challenge to instrument designers and provided the momentum to improve x-ray sources and dosimetry techniques. In this paper, the present state-of-the-art in low energy x-ray characterization techniques is reviewed. A summary is given of low energy x-ray generator technology and dosimetry techniques including a discussion of thin window proportional counters and ionization chambers. A review is included of the widely used x-ray data bases and a sample of ultrasoft x-ray measuring techniques is discussed.

4402 Radiation Effects On Instrument Components, Instruments, Or Electronic Systems

REFER ALSO TO CITATION(S) 23277

4403 Miscellaneous Instruments

REFER ALSO TO CITATION(S) 20913, 21017, 21439, 21623, 21958, 22328, 22349, 23701

22522 **(CEA-CONF—8997) Gamma teletopography.** Simonet, G. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Inst. de Recherche Technologique et de Developpement Industriel (IRDI)). Jun 1987. 13p. (In French). (CONF-870501—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88752128/JAW.

From 6. ASTM-Euratom symposium on reactor dosimetry; Jackson Hole, WY, USA (31 May 1987).

The mapping of gamma sources radiation emission in a nuclear plant is an important safety point. A remote gamma ray mapping process was developed in SPS/CEA/SACLAY. It uses the "pinhole camera" principle, precursor of photography. It mainly consists of a radiation proof box, with a small orifice, containing sensitive emulsions at the opposite. A first conventional photographic type emulsion photographs the area. A second photographic emulsion shows up the gamma radiations. The superim position of the two shots gives immediate informations of the precise location of each source of radiation in the observed area. To make easier the presentation and to improve the accuracy of the results for radiation levels mapping, the obtained films are digitally processed. The processing assigns a colours scale to the various levels of observed radiations. Taking account physical data and standard parameters, it gets possible to estimate the dose rate. The device is portable. Its compactness and fully independent nature make it suitable for use anywhere. It can be adapted to a remote automatic handling system, robot... so as to avoid all operator exposure when the local dose rate is too high.

22523 **(CONF-880462—3) A hardware/software system for implementing geophysical diffraction tomography.** Witten, A.J.; King, W.C. (Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville (USA)). 1988. Contract AC05-84OR21400. 15p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006411/JAW.

From SPIE's technical symposium on optics, electro-optic and sensors; Orlando, FL, USA (4 Apr 1988).

Geophysicl diffraction tomography is a technique for high resolution, quantitative imaging of subsurface cross-sections. The method is based upon an imaging process known as filtered backpropagation. In backpropagation, an image of spatial variations in refractive index is formed by backpropagating data received along an array of detectors, by means of the reduced wave equation, from the array into the support volume of the host medium. While there has been considerable development in theory of backpropagation, less effort has been devoted to problems associated with its implementation. Problems of practical importance that must be considered include: (1) the development of a data acquisition system capable of resolving the necessary wave characteristics; (2) quantification of the incident field in a homogeneous host matrix; and (3) infield, real-time signal processing. This paper describes a microprocessor-based data acquisition system specifically designed and fabricated for geophysical diffraction tomography discusses signal processing algorithms which are implemented on the system and presents results of several field studies. 12 refs., 4 figs.

22524 **(CONF-8709162—Summ.) Proceedings of the lightning threat warning workshop.** (Lawrence Livermore National Lab., CA (USA)). 1987. Contract W-7405-ENG-48. 114p. NTIS, PC A06. Order Number DE88006607/JAW.

From Lightening threat warning workshop; Cocoa Beach, FL, USA (15 Sep 1987).

This volume contains the proceedings of a workshop on lightning detection and warning. Papers from government and private industry researchers are presented. The topics of the papers cover electric field sensors, mathematical models of thunderclouds, lightning damage mechanisms, and future warning systems. Briefings are included which summarize each participant's involvement with lightning threats. Papers are indexed separately. (JDH)

22525 **(CONF-8711154—1) Solid state amperometric sensors for the detection of hazardous compound.** Buttner, W.J.; Flanagan, G.M.; Maclay, G.J.; Stamoudis, V.; Stetter, J.R.; Zaromb, S. (Argonne National Lab., IL (USA); Illinois Univ., Chicago (USA); Transducer Research, Inc., Naperville, IL (USA)). 1987. Contract W-31109-ENG-38. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005949/JAW.

From U.S. Army Chemical, Research, and Development Center conference; Aberdeen Proving Grounds, MD, USA (27 Nov 1987).

Miniaturized amperometric chemical sensors designed to detect trace levels of hazardous vapors are being developed by two related approaches. Active sensors have been fabricated with microelectronic techniques on Nafion, a solid organic proton conductor. A variety of working electrode designs were fabricated with different grid densities in order to investigate the relationship between sensor geometry and analytical performance. Although sensitive sensors have been fabricated utilizing Nafion as a solid electrolyte support, there are certain properties of Nafion which may ultimately limit its applicability to micro-fabrication techniques (e.g., changes in volume following contact with moisture). Alternative solid electrolyte materials are being incorporated into water-free amperometric sensors. $RbAg_4I_5$, a solid electrolyte, has been successfully used in a solid state amperometric sensor with a platinum working electrode and a silver counter and reference electrode. These sensors were evaluated in terms of response time, sensitivity, and lifetime. 7 refs., 2 figs., 2 tabs.

22526 **(DOE/SF/16499—T3) Interferometric encoder techniques: Final report, September 29, 1986-January 15, 1988.** Tansey, R.J.; Hirs, J.; Widen, K.; Needham, G.; Muenter, S.; Holly, S.; Hindy, R.N. (Rockwell International Corp., Canoga Park, CA (USA). Rocketdyne Div.). 8 Jan 1988. Contract AC03-86SF16499. 55p. (RI/RD—88-106). NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88004696/JAW.

Photon and particle beam pointing systems depend for accuracy on the integrity of a mechanical structure that supports its key components. Minute bending and deformations of mechanical structures introduce angular errors into the pointing process that cannot easily be removed. To maintain pointing accuracies of a system in the tens of nanoradians, bending and deformation of a mechanical structure must be kept under control. There is no current technology that can perform these angular measurements that satisfy the envisioned requirements on angular resolution, total angular dynamic range and angular velocity. The present contract was used to develop the required technology in response to the envisioned requirements in this area of the Strategic Defense Initiative. As will be shown in this report, the measurement techniques that are developed may equally be applied to measure either linear or angular translations. The most frequently adopted approach in non-contact distance measurement (either linear or rotary) utilizes 2 readout stations (gates) that are positioned along a periodic structure (optical, magnetic, etc.) so that they are in phase quadrature with respect to one another. Either the periodic structure or the dual gate assembly moves with respect to the other. During translation the 2 gates produce 2 periodic signals, which are 90^0 out of phase, and allow determination of travel direction in addition to measurement (in terms of number of periods of the periodic structure) of the distance traveled.

22527 **(EML—495) A portable power source for the HP-IL/RS-232 HP82164A interface.** Latner, N.; Boyle, M.; Gogolak, C.V. (USDOE Environmental Measurements Lab., New York). Feb 1988. 11p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006213/JAW.

A battery operated power supply has been developed, which powers the serial interface connected between a portable multichannel analyzer and a portable computer. This frees the system of

all line power constraints and thus facilitates spectroscopic measurements in remote locations. 4 refs., 3 figs.

22528 **(EUR—10695) Development of a stress gauge for borehole using photoelasticity.** Massal, P.; Caye, R.; Recan, M. (Commission of the European Communities, Luxembourg). 1986. 105p. (In French). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88752102/JAW.

In the framework of the research and development program on storage and disposal in geologic formation stresses in boreholes are measured by overcoring. The principle is stress release by coring around the rock where determinations are carried out. The aim of the present work is the realisation in laboratory of a gauge model based on this principle and measuring deformations by photoelasticity.

22529 **(IAE—4282/14) System of spectrometric data transmission for multi-detector devices.** Abramov, A.A.; Buturlin, V.I.; Meleshko, E.A.; Olejnik, S.V.; Polevoj, R.M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1986. 15p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701570/JAW.

A system of spectrometric data transmission from several ionizing radiation detectors distant from recording equipment via a single communication line based on the pulse-width modulation principles is described. The data belonging to a certain radiation detector can be recognized by the output signal duration of the detector electronic circuits. The analogue method of spectrometric data transmission from several ionizing radiation detectors via a single communication line enables to reduce data distortion caused by superposition of separate detector pulses in the communication line 2-3 times as compared with the digital ones at similar amplitude resolution of both methods. The developed system is designed for connection of up to 12 removable detectors to a party line. This number of detectors is limited mainly by data distortion in the communication line caused by superpositions of pulses from separate detectors. 3 refs.; 6 figs.

22530 **(IFVE-OEA—86-112) Studying the digital servosystem for measuring platform in the mode of velocity stabilization.** Galitsina, N.F.; Zajtsev, L.F.; Skvortsov, V.V.; Ustinov, E.A.; Ukhanov, M.N.; Chernyavskij, N.N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 15p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701586/JAW.

Submitted to the journal Instrum. Exp. Tech. .

The digitizing principle for charged particle tracks in devices with automated data reading-out and diameter regulation in polymer fibre production have raised a problem of equipping these devices with stable high-speed digital control systems. There are rigid requirements to stability in such systems not only for average velocity but also for instantaneous velocity of a controlled entity with pulsations not greater than 1% in the 100 control range. A digital servosystem for velocity stabilization is proposed. The effects of kinematic transmission and pulsed voltage supply on amplitude and frequency of controlled entity self-excited oscillations is considered. The method and results of measurements of pulsation amplitudes of the measuring platform instantaneous velocity are given. The developed method and device enable to measure the instantaneous velocity pulsation amplitude in the 6-12000 revol/min range, while the measurement error at low velocities is not greater than 3x10/sup -3/. 7 refs.; 7 figs.

22531 **(ITEF—24(1987)) High-voltage inverse-square function generator.** Belovolov, O.V.; Bol'shakov, A.E.; Dubinin, I.V.; Nikolaev, V.I.; Semenov, A.L. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 20p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701109/JAW.

Calculation and block-diagram of a high-voltage inverse-square-law function generator for using as a functional unit of an electrodynamic analyzer mass spectrometric system are given. The generator comprises a pulse shaping unit, a high-voltage fast switch, a control unit of transient process parameters and several RC circuits with code-controlled capacitors. Sufficiently high amplitude, fast response and pulse generation accuracy as well as a wide dynamic range make the generator useful for analysis of energy distributions of laser plasma ion components in a wide range of masses and energies. 4 refs.; 3 figs.; 3 tabs.

22532 **(JINR—R-7-86-322, pp 60) Pulsed laser charge-exchange device.** Bogdanov, D.D.; Sidorchuk, S.M.; Timakov, V.A.; Rodin, A.M.; Ter-Akop'yan, G.M. 1986. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780065/JAW.

In Heavy ion physics - 1985. Collection of annotations of the Nuclear Reaction Laboratory of the Joint Nuclear Research Institute works, 1985.

22533 **(JINR—R-7-86-322, pp 61) Ion detector for high-sensitivity mass spectrometer with a laser source.** Bogdanov, D.D.; Orlova, O.A.; Portil'o, P.; Rodin, A.M.; Timakov, V.A.; Ter-Akop'yan, G.M. 1986. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780065/JAW.

In Heavy ion physics - 1985. Collection of annotations of the Nuclear Reaction Laboratory of the Joint Nuclear Research Institute works, 1985.

22534 **(JINR—R-7-86-322, pp 67-68) Measuring and calculating complex.** Fefilov, B.V.; Vakatov, V.I.; Nefed'ev, O.K.; Strekalovskij, O.V. 1986. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780065/JAW.

In Heavy ion physics - 1985. Collection of annotations of the Nuclear Reaction Laboratory of the Joint Nuclear Research Institute works, 1985.

22535 **(LBL—24477) Improved methods for high resolution electron microscopy.** Taylor, J.R. (Lawrence Berkeley Lab., CA (USA)). Apr 1987. Contract AC03-76SF00098. 149p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88005731/JAW.

Existing methods of making support films for high resolution transmission electron microscopy are investigated and novel methods are developed. Existing methods of fabricating fenestrated, metal reinforced specimen supports (microgrids) are evaluated for their potential to reduce beam induced movement of monolamellar crystals of $C_{44}H_{90}$ paraffin supported on thin carbon films. Improved methods of producing hydrophobic carbon films by vacuum evaporation, and improved methods of depositing well ordered monolamellar paraffin crystals on carbon films are developed. A novel technique for vacuum evaporation of metals is described which is used to reinforce microgrids. A technique is also developed to bond thin carbon films to microgrids with a polymer bonding agent. Unique biochemical methods are described to accomplish site specific covalent modification of membrane proteins. Protocols are given which covalently convert the carboxy terminus of papain cleaved bacteriorhodopsin to a free thiol. 53 refs., 19 figs., 1 tab.

22536 **(PTB-E—29) Development of multijunction thermal converters for accurate ac-dc transfer.** Klonz, M. (Physikalisch-Technische Bundesanstalt, Braunschweig (Germany, F.R.). Abt. Elektrizitaet; Technische Univ. Braunschweig (Germany, F.R.). Fakultaet fuer Maschinenbau und Elektrotechnik). Mar 1987. 160p. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88752005/JAW.

For the transfer of alternating voltage and current to the equivalent direct units, Multijunction Thermal Converters (MJTC's) have been developed, the uncertainty of which are in the range of the uncertainty of the maintenance of the electrical units. A new MJTC construction is described which allows to control all important parameters during the manufacturing process which determine the ac-dc transfer difference and the temperature coefficient of the output voltage. A detailed analysis of different effects causing the temperature coefficient of thermocouples made by partially plating CuNi44-wire with Cu shows the dependence of the

temperature coefficient on the thickness of the Cu-layer. Due to the almost ideal periodic structure of the manufactured thermal element the transfer difference caused by thermoelectric effects is shown theoretically and by experiment to be smaller than 1x10/sup -8/. The frequency dependence of the ac-dc transfer differences has been evaluated in the range from 10 Hz to 100 kHz with a total uncertainty of a few parts in 10/sup 7/.

22537 **(SAND—88-0377C) High energy tomography system.** Sharp, C.L. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 7p. (CONF-880160—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88006200/JAW.

From 30. meeting of the Weapons Agencies Nondestructive Testing Organization (WANTO); Largo, FL, USA (12 Jan 1988).

This paper is presented to the 30th WANTO meeting to inform on the development status of our 2.5 MeV, high energy, tomography system. A brief description of the current status of the hardware and software is given along with descriptions of work yet to be done. The six major components of this tomographys system are a electrostatic accelerator, computer system, image processor, thirty-two channel detector array, test object manipulator, and an array processor with a back projector. 2 figs.

22538 **(UCRL—96102) Dispersion measurements of microcrystals in the near ultraviolet and infrared.** Davis, L.E. (Lawrence Livermore National Lab., CA (USA)). 10 Dec 1987. Contract W-7405-ENG-48. 19p. (CONF-8708110—32). NTIS, PC A03/MF A01; GPO Dep. Order Number DE88006234/JAW.

From 31. SPIE annual international technical symposium on optical and optoelectronic applied science and engineering; San Diego, CA, USA (16 Aug 1987).

A modified spindle stage refractometer is described for measuring the refractive indices of transparent materials. Determinations are made on small, single crystal fragments 50 μm in size and yield accurate data on the principal refractive indices over the spectra region 0.38 to 1.10 μm. The technique has been applied to study new harmonic generating crystals and the results used to predict phasematching properties and noncritical wavelengths. The spindle stage refractometer is especially useful for screening candidate materials, because accurate linear optical properties may be determined without requiring extensive crystal growth of each compound. 13 refs., 3 figs., 2 tabs.

22539 **High precision alignment of x-ray transmission diffraction gratings.** Hawryluk, A.M.; Hill, S.L. (University of California, Lawrence Livermore National Laboratory, Livermore, California 94550). *Review of Scientific Instruments;* **59**: No. 3, 420-422(Mar 1988).

Gold transmission diffraction gratings used for x-ray spectroscopy must often be aligned rotationally to within submilliradian accuracy of an instrument axis. Currently, these gratings have a high line density (grating periods less than 300 nm) so conventional techniques (such as optical imaging or diffraction) which have been used previously to determine the grating orientation cannot work. Other techniques (such as polarization effects) give <1-mrad accuracy. We describe here a simple technique that allows one to produce an optically observable alignment mark that is oriented parallel to the grating direction within a few microradians. We "write" a line, ~0.01-mm wide, directly on the grating by exposing an electron-beam-sensitive coating of polymethylmethacrylate (PMMA) on the grating while driving the grating through the beam of a scanning electron microscope (SEM). The direction of motion is made parallel to the grating lines by controlling the stage motion with a joystick while inspecting the grating in the SEM. Using the joystick, one can "follow" a single grating line from end to end. The SEM written line is made a permanent addition to the grating by ion-beam etching or gold microplating, and can later be used for in situ alignment verification. Our lines have been made parallel to the original grating lines to approximately +- 5 μrad; this alignment can be extended to +- 1 μrad. Standard optical techniques can be used to align the grating with respect to an arbitrary instrument axis. This technique works equally well with transmission and reflection gratings.

22540 **Compact low-energy Mott polarimeter for use in energy- and angle-resolved polarization studies.** Tang, F.; Zhang, X.; Dunning, F.B.; Walters, G.K. (Department of Physics and the Rice Quantum Institute, Rice University, P. O. Box 1892, Houston, Texas 7251). *Review of Scientific Instruments;* **59**: No. 3, 504-505(Mar 1988).

A simple low-voltage (20-kV) UHV-compatible Mott polarimeter is described that incorporates an in-line retarding potential energy analyzer that, at incident electron energies ≦50 eV, provides an energy resolution of ≦0.5 eV. The polarimeter is very compact and is suitable for use in a wide variety of applications requiring energy- and angle-resolved polarization measurements.

22541 **Resolving power of 35,000 (5 mA) in the extreme ultraviolet employing a grazing incidence spectrometer.** Hettrick, M.C.; Underwood, J.H.; Batson, P.J.; Eckart, M.J. (Hettrick Scientific, P. O. Box 8046, Berkeley, California 94707). *Applied Optics;* **27**: No. 2, 200-200(15 Jan 1988).

The performance of a high-resolution spectrometer employing a varied line-space plane reflection grating is measured. (AIP)

22542 **(JINR—D-3,4,17-86-747, pp 153-174) New results and future projects in perfect crystal interferometry.** Rauch, H. (Atominstitut der Oesterreichischen Universitaeten, Vienna). 1987. NTIS (US Sales Only), PC A21/MF A01. Order Number DE88780064/JAW. (CONF-8610176—).

From 5. international school on neutron physics; Alushta, USSR (20 Oct 1986).

Recent neutron interferometric results obtained by Dortmund-Grenoble-Vienna interferometer group working at the high flux reactor at Grenoble are presented. A nondispersive sample position and the difference between stochastic and deterministic absorbers is discussed. Polarized neutron interferometry takes much attention. The 4π-symmetry of spinor wave functions, the quantum mechanical spin superposition law and double resonance coil experiments are discussed in detail. A related quantum beat experiment achieved an energy sensitivity of 2.7 x 10/sup -19/ eV. Phase echo systems, experiments with chopped beams and multiplate interferometry are discussed as examples for forthcoming experiments. 65 refs.; 11 figs.

22543 **Microwave propagation through an apertured coaxial waveguide.** Peter, W.; Kwan, T.J.T. (Applied Theoretical Physics Div., Los Alamos National Lab., Los Alamos, NM 87545). pp 61 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

The authors studied the phenomena of microwave transmission through coaxial waveguides with a single aperture in the linear and nonlinear regimes. In the linear regime where power level of the microwave radiation is low enough not to cause electrical breakdown of the ambient medium and field emission of electrons, their analytic and numerical results showed that the propagation of microwaves depends on the excitation of higher order modes. They found that transmission of microwave power is sensitive to the microwave frequency and waveguide geometry. In the nonlinear regime where electron field emission can occur across the aperture, the transmission characteristics can be quite different. In a vacuum, if the microwave amplitude is sufficiently strong such that E/sub o/ > mω/sup 2/d/e where E/sub o/ and ω are the amplitude and frequency of the microwave radiation respectively, and d is the width of the aperture, the field-emitted electrons can effectively close the aperture and deny the microwave transmission. The authors used the 2-1/2 dimensional fully electromagnetic relativistic plasma simulation code ISIS to verify our analytic results. Their simulations also indicated that for much higher power flow, the gap may reopen, so that microwave power is transmitted. This phenomena is due to the E x B force causing significant longitudinal excursion of the electrons if Ω/sup 2/T/ω >> 1, where T is the electron transit time in the gap, and Ω is the electron gyroradius. If Ω/sup 2/T/ω << 1, aperture closure will happen. The theoretical predictions are in good agreement with the results from the simula-

tions. They also present results in the nonlinear regime where electrical breakdown of the ambient medium at various pressure occurs.

22544 **Simple x-ray camera system.** Chia, C.S.; Rhee, M.J.; Weidman, D.J.; Yang, D.I.; Schneider, R.F. (Lab. for Plasma and Fusion Energy Studies, Univ. of Maryland, College Park, MD 20742). pp 75 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

The authors describe a simple, highly sensitive x-ray camera system which is useful for x-ray imaging applications such as pinhole photography and spectrography. The camera system, consisting of a phosphor screen and an oscilloscope camera, requires virtually no construction work. The phosphor screen is mounted on the front side of the scope camera such that the optical image of the screen is focused onto the camera film plane.

22545 **Time-resolving Thomson spectrometer.** Weidman, D.J.; Rhee, M.J. (Lab. for Plasma and Fusion Energy Studies, Univ. of Maryland, College Park, MD 20742). pp 75-76 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

The Thomson spectrometer is a very useful diagnostic for ion beams since it provides the distribution of particles as a function of energy, momentum, and charge-to-mass ratio, simultaneously. No temporal information, however, is provided. The authors assembled a time-resolving Thomson spectrometer system designed to analyze an ion beam with a large energy spread and a short time duration. They used it to obtain a temporal distribution of the ions from a plasma focus ion source which has a duration of several nanoseconds. A time-integrating Thomson spectrometer utilizes parallel E/sup →/ and B/sup →/ fields, which are produced by a pair of permanent magnets which also serve as electrodes. The detector plate is CR-39 plastic which is etched in an NaOH solution after exposure to ions to reveal the pattern of ion tracks. The track pattern of a time-integrated spectrogram is a family of parabolas, indicating ions with different charge-to-mass ratios.

22546 **(DOE/MC/21353—T1) IR spectroscopic measurement of HCl in flue gas using the 677 IR HCl-measuring system.** Berkhahn, W.; Wiedeking, E. Translated from *VGB Kraftwerkstechnik ;* **63**: No. 9, 801-806(Sep 1983). Contract AC21-85MC21353. 17p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005045/JAW.

In accordance with the First General Administrative Regulation on the Bundes-Immissionsschutzgesetz [Federal Emissions Control Act of West Germany], referred to as "TA Luft," "plants with gaseous emissions of more than 1 kg/h organic gaseous chlorine compounds - given as chlorides (Cl^-) - must be equipped with a measuring device that continuously records the concentration by weight of these substances, for the purpose of monitoring the effectiveness of emissions reduction measures. TA Luft also specifies that measuring equipment that has been declared suitable by the Bundesminister des Innern (BMI) [Federal Minister of the Interior] must be used for monitoring purposes. In conjunction with a BMI research project, several wet-chemical devices were examined by Technisches Ueberwachungs-Verein Rheinland e.V. for their suitability. Only one of the devices could be recommended with limitations. With the HCl emission measuring system 677 IR presented here, there is for the first time the possibility of carrying out hydrogen chloride determination according to a physical process, i.e., measurement of the optical IR absorption of the HCl molecule. The type test of this measuring system has now been concluded with positive results. The measuring principle of the process photometer Spectran 677 IR is explained and the sampling system described. The operating experience acquired with the measuring system is discussed on the basis primarily of test results at TUEV Norddeutschland e.V. The maintenance cost involved in the use of the device is discussed in detail. 5 refs., 8 figs., 3 tabs.

45 EXPLOSIONS AND EXPLOSIVES

4501 Chemical

22547 **(SAND—83-1788) Transient compressible flow in porous materials.** Shepherd, J.E.; Begeal, D.R. (Sandia National Labs., Albuquerque, NM (USA)). Jan 1988. Contract AC04-76DP00789. 63p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88006685/JAW.

An experimental investigation of transient compressible flow in porous materials is reported. Two types of experiments have been carried out to verify the simplified models of compressible flow that have been developed by other investigators over the last decade and to extend the drag coefficient measurements to high Reynolds numbers. Results are reported for packed beds constructed from glass beads and three types of granular explosives: CP, HMX, and HNS. 12 refs., 24 figs., 4 tabs.

22548 **(SAND—87-2191C) Stability of the high-temperature G-16 primer composition.** Durand, N.A.; Weinmaster, R.R.; Massis, T.A.; Fleming, W. (Sandia National Labs., Albuquerque, NM (USA); Unidynamics, Phoenix, AZ (USA)). 1988. Contract AC04-76DP00789. 7p. (CONF-880473—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88006201/JAW.

From American Defense Preparedness Association Compatibility symposium; New Orleans, LA, USA (18 Apr 1988).

The stability of the G-16 pyrotechnic primer mixture of antimony sulfide, calcium silicide, and potassium chlorate was studied at temperatures up to 200°C in sealed and open environments. Data have shown that this mixture is stable in open environments at 200°C for up to 48 hours. However, in sealed, limited volume environments, the mixture completely decomposes within 24 hours at 200°C. In sealed environments, the mixture shows stability with copper present. Both functional testing and chemical analysis were used to evaluate the primer composition after temperature exposure. The degree of degradation of the mixture was determined from the concentration of final reaction products (sulfate and chloride ions), using ion chromatography. When copper was present, the intermediate reaction products were scavenged by the copper, and the degradation was reduced. The role of copper in the reaction was verified with differential scanning calorimetry and surface analysis. 3 refs., 9 figs., 2 tabs.

4502 Nuclear

22549 **(AD-A—186831/4/XAB) Threats to survival in a nuclear environment. Research report.** Pasini, R. (Air War Coll., Maxwell AFB, AL (USA)). May 1987. 59p. (AU-AWC—87-162). NTIS, PC A04/MF A01.

This report describes the primary threats to survival during and after a nuclear attack, focusing on the weapons effects of blast, thermal and short- and long-term radiation. Simple rules are discussed for self-protection from fallout. Myths, facts, and some philosophy on how to survive a nuclear attack are presented.

22550 **(AD-A—187541/8/XAB) Debris charge states in HANE (high-altitude nuclear explosion) and in the NRL (Naval Research Laboratory) laser experiment. Interim report.** Hyman, E.; Mulbrandon, M.; Giuliani, J.L. (Naval Research Lab., Washington, DC (USA)). 30 Oct 1987. 24p. (NRL-MR—6085). NTIS, PC A03/MF A01.

It is shown that in the NRL laser experiment the expanding-debris ions remain highly charged, in contrast to the situation in a high-altitude nuclear explosion (HANE) in which recombination to a low charge state is rapid. The difference in the two cases is a result of (1) a failure in the scaling of debris density relative to a HANE in the early expansion phase (2) a failure in scaling of the energy-deposition time. Results based on simple idealized models for the HANE and laser experiment are presented, and these are compared with more-sophisticated calculations.

22551 **(PB—88-138086/XAB) Crisis management in the nuclear age.** Rusten, L.; Stern, P.C. (National Research Council, Washington, DC (USA)). 1987. 56p. NTIS, PC A04/MF A01.

This report examines the management tasks and problems that face leaders of the superpowers in international crises: gathering and assessing information, identifying and evaluating options, coordinating the functions of huge and complex organizations communicating with adversaries and allies, and implementing decisions through far-flung human and technological organizations, all in a compressed period of time and with immensely high stakes. It also discusses various ideas for improving crisis management. The report emphasizes, however, that crisis resolution sometimes competes with other goals of national leaders. Although the report raises more issues than it resolves, it is hoped that increased recognition of the problems can aid crisis management by making decision-makers more consciously aware of the complex bureaucratic, psychological, and technical interactions that can affect the success of their efforts.

22552 **(PB—88-142450/XAB) Modernizing US strategic offensive forces: costs, effects, and alternatives.** (Congressional Budget Office, Washington, DC (USA)). Nov 1987. 101p. NTIS, PC A06/MF A01.

United States strategic forces are primarily intended to deter the Soviet Union from initiating a nuclear war. To do so, U.S. policy calls for them to be able to survive a Soviet nuclear strike and retaliate in an appropriate and timely manner. Since the 1960s, the Soviets have upgraded and significantly expanded the capabilities of their strategic forces. The Administration believes that, in response, the United States must increase not only the numbers of its forces and their chance of surviving a Soviet strike, but also their destructive capability, endurance, and responsiveness.

22553 **(PB—88-142542/XAB) Consequences of nuclear war.** (International Council of Scientific Unions, Paris (France)). 16 Sep 1986. 99p. NTIS, PC E04/MF A01.

Contents include: The SCOPE ENUWAR Report on the climatic consequences of nuclear war; Climatic consequences of nuclear war; Medical consequences of nuclear war; Nuclear war--consequences on ecological, agricultural, and human systems; Societal consequences of nuclear war - citing the experiences of Hiroshima and Nagasaki.

22554 **(PB—88-857222/XAB) War gaming for strategic and tactical nuclear warfare. January 1970-January 1988 (citations from the NTIS data base). Report for January 1970-January 1988.** (National Technical Information Service, Springfield, VA (USA)). Jan 1988. 170p. NTIS PC N01/MF N01.

Supersedes PB—87-855318.

This bibliography contains citations concerning non-quick war gaming for strategic and tactical nuclear warfare. Analyses and comparative evaluations, based upon computerized simulations, are considered as are manuals and specification for the various computer programs employed. Stage 64 and Satan II and III are covered prominently. (This updated bibliography contains 356 citations, 36 of which are new entries to the previous edition.)

22555 **(UCID—21079-Rev.1) Analysis of downhole canister alignment based on historical data.** O'Neal, W.C. (Lawrence Livermore National Lab., CA (USA)). 20 Jan 1988. Contract W-7405-ENG-48. 47p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006593/JAW.

The purpose of the alignment project is to study, understand and control diagnostics canister deflection (misalignment) which occurs during the stemming of underground nuclear test hardware. Typically, the canister assembly consists of an 86-in.-diam by 15-ft-long device canister bolted to a 68- or 86-in.-diam by 100-ft-long diagnostics canister above. The assembly is pre-aligned and lowered down an 86-to-120- in.-diam borehole 700-to-2200-ft deep. As many as 200 electrical power and signal cables are attached to the canister and banded to the emplacement pipe as it is lowered. This document reports on one of the tasks of the study: to expand and analyze a database of deflection-related historical engineering information.

50 ENVIRONMENTAL SCIENCES, ATMOSPHERIC

5001 Basic Studies

REFER ALSO TO CITATION(S) 22524, 23130, 23131, 23203, 23204, 23206, 23207

22556 **(GSF—10/87) Climate and weather as related to the novel forest disease. Proceedings.** (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Projektgruppe Bayern zur Erforschung der Wirkung von Umweltschadstoffen (PBWU)). Mar 1987. 308p. (In German). (CONF-8610391—). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88752006/JAW.

From Symposium on climate and weather as related to the novel forest disease; Neuherberg, F.R. Germany (13 Oct 1986).

The conference illustrates the role played by applied meteorology respectively climatology in the discussion about the environment. With reference to research on forest die-back models and measurements are described by which it is possible to assess the burden on forests from climatic and anthropogenic factors of harm. A number of contributions studied possible reactions of plants to climatic stress from the angle of biological impact research. Much space was dedicated to the assessment of the position of climate and weather among all the factors of damage discussed. In particular, an interpretation was given of the increment curves of forest trees in the past decades in respect of the weather situations or weather extremes these involved.

22557 (GSF—10/87, pp 1-18) **Accompanying meteorological measurements in sites of forest disease research.** Dirmhirn, I. (Universitaet fuer Bodenkultur, Vienna, Austria. Inst. fuer Meteorologie, Klimatologie und Grundlagen der Physik). Mar 1987. (In German). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88752006/JAW. (CONF-8610391—).

From Symposium on climate and weather as related to the novel forest disease; Neuherberg, F.R. Germany (13 Oct 1986).

Meteorology contributes to the verification of damage in forest systems by activities to be categorized as follows: climatic standard measurements, to determine the impact of weather on the ecosystem forest in the year of reference; extended investigations of air flow to link areas of emission with the immission area; microclimatic investigations of the system forest, to elucidate the mechanisms by which the physical system functions, specifically: by which it transports pollutants; special bioclimatic measurements covering causal relationships between trees, input of chemical substances, harmful insects and parameters of microclimate or groups of such parameters; and large-scale surveying of forest disease. The paper deals with each of the measuring projects mentioned separately.

22558 (GSF—10/87, pp 19-50) **Model instruments to investigate large-scale input of substances in forest areas.** Pankrath, J. (Umweltbundesamt, Berlin, Germany, F.R.). Mar 1987. (In German). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88752006/JAW. (CONF-8610391—).

From Symposium on climate and weather as related to the novel forest disease; Neuherberg, F.R. Germany (13 Oct 1986).

The discussion about the input of pollutants in ecosystems currently focusses on emissions entailing the formation of acids and photooxidants, followed by heavy-metal emissions. In Europe, by far the greatest part of those emissions results from anthropogenic activities. The paper describes large-scale immissions and depositions and establishes an atmospheric sulfur balance for Europe. Propagation models described are TADAP and the EUM model of the German Weather Service.

22559 (GSF—10/87, pp 51-65) **Numerical simulation of air currents in and above forests.** Gross, G. (Technische Hochschule Darmstadt, Germany, F.R. Inst. fuer Meteorologie). Mar 1987. (In German). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88752006/JAW. (CONF-8610391—).

From Symposium on climate and weather as related to the novel forest disease; Neuherberg, F.R. Germany (13 Oct 1986).

The FITNAH model developed at Darmstadt was extended in a way permitting realistic consideration even of high vegetation (forest). By means of the modified simulation model, calculations were carried through both with and without consideration of forest. The latter case may be interpreted as an event of extreme forest disease, namely supposing that all trees have been felled. The comparison of results permits an assessment as to the modifications in the distribution of meteorological quantities that are liable to occur in case of extreme forest disease.

22560 (GSF—10/87, pp 76) **Possibilities for climate and weather to influence forest ecosystems.** Baumgartner, A. (Muenchen Univ., Germany, F.R.). Mar 1987. (In German). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88752006/JAW. (CONF-8610391—).

From Symposium on climate and weather as related to the novel forest disease; Neuherberg, F.R. Germany (13 Oct 1986).

The high forests currently existing grew in a period of optimum climate which came to an end between 1940 and 1950. It is some 1000 years ago that an equivalent climate existed for the last time. The climatic optimum had a favourable effect on forestry because it resulted in volume increment and plantation-type spruce forests. This disturbed the nutrient balance between soil and plants. Clues to a change of climate have since been: changes of radial growth increment, accumulation of glaciers, shifting discharge and climatic parameters. After the optimum of climate, summer droughts, years of excessive fruit yield, mild weather late in autumn with protracted beginning of winter and development of incomplete frost resistance, abrupt rises in temperature in mid-winter with subsequent drop to frost temperatures and mechanical needle damage, copious snowfalls after the end of winter with needle thinning were rife. Repetitions in the years after had an aggravating effect especially in stands of extreme density with inadequate crowns of trees. The supraregional nature of changes of climate suggests that these may have a dominating influence on forest decline.

22561 (GSF—10/87, pp 131-138) **Climate data relevant for the assessment and investigation of forest disease.** Hoffmann, L. (Deutscher Wetterdienst - Zentralamt, Offenbach am Main, Germany, F.R.). Mar 1987. (In German). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88752006/JAW. (CONF-8610391—).

From Symposium on climate and weather as related to the novel forest disease; Neuherberg, F.R. Germany (13 Oct 1986).

The explanations are restricted to precipitations. Proper preparation of data to evaluate precipitation shows that there always are several years in sequence when values are either lower or higher than the mean ones. This is a fact for instance as regards the location of Bavaria for large-scale circulation. It results as a rule in a sequence of years with either too damp or to dry weather. There does not seem to be any underlying regularity. But there are signs which seem to indicate that the difference between dry and wet periods has increased on the whole since about 1930.

22562 (GSF—10/87, pp 269-275) **Climate and tree diseases.** Kandler, O. (Muenchen Univ., Germany, F.R. Botanisches Inst.). Mar 1987. (In German). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88752006/JAW. (CONF-8610391—).

From Symposium on climate and weather as related to the novel forest disease; Neuherberg, F.R. Germany (13 Oct 1986).

Photographs furnish evidence that crown damage corresponding to current descriptions and photographs of novel forest disease has long existed and that its course corresponds more to biotic diseases than to damage from weather events and other abiotic factors. Part of these symptoms probably represent the impact of known tree disease as late consequences of stem and root rot. Elucidation of the diseases entailing the thinning of crowns and/or persistent growth inhibition is indispensable if the importance of climatic factors for the course of diseases is to be understood.

22563 (N—88-13774) **Scientific and Operational Requirements for TOMS Data.** Krueger, A.J. (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center). Dec 1987. 112p. (NASA-CP—2497; REPT—87B0206; NAS—1.55:2497; CONF-8609399—). NTIS, PC A06/MF A01.

From Scientific and operational requirements for TOMS data; Greenbelt, MD, USA (10 Sep 1986).

Global total ozone and sulfur dioxide data from the Nimbus 7 Total Ozone Mapping Spectrometer (TOMS) instrument have applications in a broad range of disciplines. The presentations of 29 speakers who are using the data in research or who have operational needs for the data are summarized. Five sessions addressed topics in stratospheric processes, tropospheric dynamics and chemistry, remote sensing, volcanology, and future instrument requirements. Stratospheric and some volcanology requirements can be met by a continuation of polar orbit satellites using a slightly modified TOMS but weather related research, tropospheric sulfur budget studies, and most operational needs require the time resolution of a geostationary instrument.

22564 (N—88-13774, pp vp) **Selection of optimum wavelengths for ozone mapping from satellites.** Bhartia, P.K. Dec 1987. NTIS, PC A06/MF A01. (NASA-CP—2497; REPT—87B0206; NAS—1.55:2497; CONF-8609399—).

From Scientific and operational requirements for TOMS data; Greenbelt, MD, USA (10 Sep 1986).

Faced with conflicting requirements for measuring total ozone with the Solar Backscatter Ultraviolet Spectrometer/Total Ozone Mapping Spectrometer (SBUV/TOMS), a recommended strategy is to select three wavelengths: one at the peak of the ozone absorption cross section spectrum, another at a nearby minimum and a third wavelength that lies just outside the absorption spectrum. A pair formed using the first two wavelengths are then used under most observing conditions; another pair formed using the last two wavelengths are used near the terminator. There is no evidence that the use of additional wavelengths provides any benefit for measuring total ozone. Additional wavelengths, however, are necessary if other atmospheric species, such as SO_2, need to be measured.

22565 (N—88-13774, pp vp) **Observation guidelines for a Total Ozone Mapping Spectrometer (TOMS) in geosynchronous orbit.** Shenk, W.E. Dec 1987. NTIS, PC A06/MF A01. (NASA-CP—2497; REPT—87B0206; NAS—1.55:2497; CONF-8609399—).

From Scientific and operational requirements for TOMS data; Greenbelt, MD, USA (10 Sep 1986).

The successful utilization of Total Ozone Mapping Spectrometer (TOMS) measurements in low Earth orbit for the analysis of rapidly changing events has led to the consideration of a TOMS in geosynchronous orbit. This orbit should allow for the selection of temporal and spatial resolutions that are specifically designed for these events, plus the flexibility of selecting different sized areas and pointing the sensor to focus on the most interesting events. Separate temporal and spatial resolution guidelines plus recommended areal coverage have been developed for tropical cyclones, jet streams, the interaction between strong convection and the environment, and the surveillance of volcanoes. It is also suggested that the most effective use of TOMS would be simultaneous flights with microwave and high spatial resolution infrared temperature profiles.

22566 (PB—88-132725/XAB) **Balloon-based infrared solar-occultation measurements of stratospheric O_3, H_2O, HNO_3, and CF_2Cl_2. Technical report.** Weinreb, M.P.; Chang, I.L. (National Environmental Satellite, Data, and Information Service, Washington, DC (USA)). Sep 1987. 35p. (NOAA-TR-NESDIS—34). NTIS, PC A03/MF A01.

In July 1985 the authors performed an infrared solar-occultation experiment with a balloon-borne, non-scanning, multi-detector grating spectrometer. From the data, the authors retrieved simultaneous mixing-ratio profiles of ozone, water vapor, nitric acid, and CF_2Cl_2 between 12 and 35 km. The retrieved ozone and water-

vapor profiles were compared with concurrent in-situ measurements with electrochemical concentration cells (ECC's) and frost-point hygrometers, respectively. The retrieved-ozone profile was in good agreement with the correlative data. The retrieved values of water-vapor-mixing ratio, while close in magnitude to the correlative measurements, differed in their altitude dependence. Although the authors had no concurrent in-situ data for nitric acid and CF_2Cl_2, the retrieved profiles were consistent with measurements in the literature.

22567 **(UCRL—21024) A survey of denser-than-air atmospheric dispersion models.** Ermak, D.L.; Rodean, H.C.; Lange, R.; Chan, S.T. (Lawrence Livermore National Lab., CA (USA)). Feb 1988. Contract W-7405-ENG-48. 49p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006626/JAW.

This survey of denser-than-air atmospheric dispersion models has been conducted by the Lawrence Livermore National Laboratory for the US Air Force Engineering and Services Center, Tyndall AFB as part of their effort to update their atmospheric dispersion modeling capability. The goal of this LLNL study is to identify the more recent denser-than-air atmospheric dispersion models proposed in the literature and to provide brief descriptions of current models. For the purposes of this survey, "more recent" is defined as the year 1980 and later. Furthermore, we do not describe every model found in this category; rather we consider only those models that appear to have been actively used and further developed during the 1980's and are therefore judged to be current. 38 refs., 2 figs., 1 tab.

5002 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 20748, 20891, 20892, 20893, 20894, 20895, 20896, 20897, 20918, 20954, 20955, 21396, 21526, 21837, 21843, 21844, 21851, 21852, 21853, 21859, 21869, 21886, 21888, 21898, 22121, 22173, 22220, 22356, 22357, 22419, 22563, 22778, 22804, 22807, 22808, 22809, 22810, 22811, 22844, 22973, 22974, 22975, 22992, 23009, 23010, 23011, 23131, 23134, 23139, 23145, 23148, 23150, 23152, 23157, 23158, 23159, 23167, 23169, 23170, 23173, 23179, 23180, 23181, 23182, 23188, 23197, 23210

22568 **(BNL—40458) Methods for spatial analysis of dry deposition flux estimates.** Lipfert, F.W. (Brookhaven National Lab., Upton, NY (USA)). Oct 1987. Contract AC02-76CH00016. 13p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004964/JAW.

This brief analysis has considered some methods for analyzing the spatial variability of dry deposition fluxes. Knowledge of such variability is important in interpreting point measurements and in estimating pollutant flux budgets. Techniques that were considered include use of fractals to describe landscape elements, the definitions of aerodynamic edges, and the uses and limitations of readily available land use/land cover data. 6 refs., 4 figs.

22569 **(DGMK—348) Test methods for monitoring of substances in the petroleum industry. Monitoring in ambient air - monitoring in biological material.** (Deutsche Wissenschaftliche Gesellschaft fuer Erdoel, Erdgas und Kohle e.V., Hamburg (Germany, F.R.)). Feb 1987. 186p. (In German). Deutsche Wissenschaftliche Gesellschaft fuer Erdoel, Erdgas und Kohle e.V., Hamburg, Germany, F.R.

Loose-leaf-collection.

The objective of the project has been to collect test methods for the monitoring of substances in air and/or their metabolites in biological material as far as these substances are important during the processing, the transportation and the use of petroleum products. The collection describes analytical procedures on the basis of scientific publications and company confidential reports which had been made available for that purpose, indications are given to other loose-leaf collections of test methods as have been published by the Deutsche Forschungsgemeinschaft and the Hauptverband der gewerblichen Berufsgenossenschaften.

22570 **(DOE/ER/60294—1) [Participation in the precipitation chemistry network]: Progress report, 1 December 1986-31 July 1987.** (Pennsylvania State Univ., University Park (USA)). 1987. Contract FG02-85ER60294. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003139/JAW.

Site operations included collection of precipitation event samples, measurement and reporting of sample pH and conductivity and precipitation depths, and servicing of the collectors and site as necessary. Per MAP3S protocol all samples were shipped to the analytical laboratories at Pacific Northwest Laboratories for more detailed analysis. Data from the precipitation samples and raingage have been logged on a routine basis according to standard procedure. A data-base management program is being set up on an IBM-PC class computer to record site-specific data. Comparisons between the precipitation pH values measured in our own laboratory and those measured in the primary laboratory at PNL have been made. This is partly an effort to assess the effects of sample storage and shipping and partly for the purpose of tracking the quality of our sample-handling procedures. While the correlation coefficient is relatively high, 0.98, suggesting overall good preservation of sample quality, several marked departures from agreement occur in specific instances. 1 fig., 1 tab.

22571 **(DOE/ER/60468—1) Design and analysis of large-scale atmospheric dispersion experiments: First annual progress report, [July 1986-March 1987].** Baer, F.; Holland, J. (Maryland Univ., College Park (USA). Dept. of Meteorology). Mar 1987. Contract FG05-86ER60468. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004924/JAW.

The objectives of this research are to develop a realistic tracer plume simulation model for evaluating designs for large-scale sampling experiments; to develop corrections for the systematic errors in estimated transport/dispersion parameters of tracer plumes which are truncated by the boundaries of the finite sampling domain; to make best estimates of the moments of observed and predicted CAPTEX '83 tracer distributions; and to determine realistic confidence limits for the best estimates of the moments of the CAPTEX '83 tracer distributions.

22572 (DOE/ER/60493—1-Vol.1, pp 154-158) **Air velocities inside domestic environments: an important parameter for passive monitoring.** Matthews, T.G.; Thompson, C.V.; Wilson, D.L.; Hawthorne, A.R.; Mage, D.T. (Oak Ridge National Lab., TN). 1987. NTIS, PC A99. Order Number DE88004513/JAW. (CONF-870853—Vol.1). Contract AC05-84OR21400.

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Air velocities have been measured in the master bedroom, kitchen, and basement of six occupied homes plus the dining/living room area of one unoccupied house. Median air velocities of 5.3 and 12.4 cm/s in the occupied and unoccupied houses raise concern that inadequate air movement may sometimes exist for accurate passive monitoring of pollutant vapors. Central-air circulation systems has a variable impact on air velocity. Median velocities increased from 5.8 to 6.2, 3.2 to 5.7, 1.5 to 8.1, and 4.4 to 15.5 cm/s in three occupied and one unoccupied houses, respectively. Median velocities of 4.2, 4.3, and 10.2 cm/s in the master bedroom, basement, and kitchen, respectively, are consistent with increased occupant activities and use of ceiling and/or exhaust fans in or near the kitchen.

22573 (DOE/ER/60493—1-Vol.2, pp 3-7) **Identification of conservative tracer of environmental tobacco smoke.** Eatough, D.J.; Benner, C.L.; Bayona, J.M.; Caka, F.M.; Mooney, R.L.; Lamb, J.D.; Lee, M.L.; Lewis, E.A.; Hansen, L.D.; Eatough, N.L. (Brigham Young Univ., Provo, UT). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Several components of environmental tobacco smoke (ETS) have been determined in experiments conducted in a 30 m^3 Teflon chamber. The effect of residence time in the chamber on the particle size distribution, mass of particles, gas-particle equilibria and chemical composition of both the gas and particle phases of ETS has been studied. Many organic compounds present in tobacco smoke condensate are not found in the particles of ETS but are present in the gas phase. The concentrations of particle phase nicotine, nicotyrine, cotinine and nonvolatile sterols and sterenes may be useful as tracers of the particle phase of ETS. Gas phase nicotine, HNO_2, myosmine and 3-vinylpyridine may prove to be useful for the source attribution of the gas phase of ETS. Concentrations of these gas and particle phase compounds from ETS are now being determined in indoor environments.

22574 (DOE/ER/60493—1-Vol.2, pp 8-12) **Environmental tobacco smoke: mutagenic emission rates and their relationship to other emission factors.** Lewtas, J.; Williams, K.; Lofroth, G.; Hammond, K.; Leaderer, B. (Environmental Protection Agency, Research Triangle Park, NC). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The objective of this study was to evaluate the emission rates and exposure concentrations of mutagens, nicotine, and particles from cigarettes. Studies were conducted under controlled laboratory and chamber conditions as well as in personal residences. The mutagenicity of environmental tobacco smoke (ETS) was evaluated in three bioassays using two strains of Salmonella typhimurium. Strain TA98 was used in the standard plate-incorporation and microsuspension histidine reversion assays; and strain TM677 in a microsuspension forward mutation assay. The mutagenicity, expressed either per μg particle mass or per μg nicotine, appeared to be a relatively constant factor that did not vary significantly between various cigarette brands. These data are being used to model the emissions of mutagens to predict mutagenic exposure concentrations under various conditions.

22575 (DOE/ER/60493—1-Vol.2, pp 39-44) **Air cleaners for tobacco smoke.** Olander, L.; Johansson, J.; Johansson, R. (National Board of Occupational Safety and Health, Solna, Sweden). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The cleaning efficiency, for gases and particles, of room air cleaners for tobacco smoke have been measured. The total number of cleaners were 34 and they were divided as follows: 12 with electrostatic precipitation, 6 with electret-fiber filters, 6 with fiber filters, 7 with ionizers and 3 with undefined filtration materials. Nine of these had activated carbon, 3 impregnated alumina and 3 a ionizing lamp or electron generator for gas cleaning. The measurements consisted of measuring aerosol particles from 0.01 to 7.5 microns and of the following gases: carbon monoxide, ammonia, formaldehyde, nitric oxide, nitrogen dioxide, hydrocarbons, hydrogen cyanide and ozone. The cleaning efficiencies were determined as the decay rate of the concentrations of the contaminants in a closed room of 100 m^3.

22576 (DOE/ER/60493—1-Vol.2, pp 47-51) **Impact of air washing on environmental tobacco smoke odor.** Clausen, G.H.; Moeller, S.B.; Fanger, P.O. (Technical Univ. of Denmark, Lungby). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Sixteen subjects evaluated the air quality in an environmental chamber polluted with tobacco smoke, with and without an air washer in operation in the recirculation loop of the air conditioning system. Four concentrations of tobacco smoke were investigated corresponding to CO-concentrations ranging from 0 to 5 ppm. The subjects assessed odor intensity, acceptability and freshness of the air. A total of 20 two-hour tests were carried out, with 6 to 10 subjects participating in each test. Although the odor intensity did not decrease when the air washer was in operation, the air in the chamber was perceived significantly fresher and more acceptable than without the air washer. A reduction in the ventilation requirement can be achieved by using an air washer.

22577 (DOE/ER/60493—1-Vol.2, pp 126-130) **Measurement of selected constituents of environmental tobacco smoke in a Winston-Salem, North Carolina restaurant.** Eudy, L.; Heavner, D.; Stancill, M.; Simmons, J.S.; McConnell, B. (R.J. Reynolds Tobacco Co., Winston-Salem, NC). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

A study was conducted to monitor levels of environmental tobacco smoke (ETS) constituents in a Winston-Salem restaurant. Concentrations of nicotine, particulate matter, and carbon monoxide were measured with a prototype, fixed-station sampler. Nicotine and particulate matter samples were collected over successive 4-h time periods while carbon monoxide readings were made at 10-min intervals. The instrumentation described in this paper permits continuous, unattended monitoring and/or collection of ETS with the advantage of 12 pre-selected sampling periods. Thus, build-up and decay of ETS components in ambient air can be detected.

22578 (DOE/ER/60493—1-Vol.2, pp 131-136) **Field study of passive smoking exposure with passive sampler.** Hammond, S.K.; Coghlin, J.; Leaderer, B.P. (Univ. of Massachusetts Medical School, Worcester). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

A sampler to measure exposure to environmental tobacco smoke (ETS) was developed on the basis of diffusion of nicotine. Nicotine, which serves as a marker for ETS, is then extracted from the filter and analyzed. The diffusion sampler was tested under controlled conditions both at constant ETS particle concentrations (between 150 and 1500 $\mu g/m^3$) and under widely varying concentrations for periods of 3 to 7 days. In a 7 day field test, 19 subjects wearing the samplers kept daily diaries of exposure to ETS. Excellent agreement ($r^2 = 0.88$) was found between the reported and the measured levels of ETS exposure. The passive samplers were simple and convenient to use.

22579 (DOE/ER/60493—1-Vol.2, pp 137-141) **Environmental tobacco smoke in real life situations.** Klus, H.; Beguter, H.; Ball, M.; Intorp, M. (Austria Tabakwerke AG, Vienna). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Concentrations of the environmental tobacco smoke (ETS) constituents such as carbon monoxide (CO), nitrogen oxide (NO), nitrogen dioxide (NO_2), hydrogen cyanide (HCN), ammonia (NH_3), formaldehyde, phenols, nicotine and N-nitrosamines were measured under real-life conditions. Maximum emission values estimated in a stainless steel test chamber (3) were related to the levels in normal indoor environments such as living rooms, offices, restaurants, pubs, railway compartments and cars. The concentration of ETS components is dependent on tobacco products smoked, aging of tobacco smoke, room ventilation and room fittings. The effects of these factors differ from substance to substance. Except for nicotine, sources other than tobacco smoke have to be taken into account as well. From our results we conclude that ETS exposure in real-life situations is not sufficiently described by measuring one single component only.

22580 (DOE/ER/60493—1-Vol.2, pp 142-146) **Personal monitoring study to assess exposure to environmental tobacco smoke.** McCarthy, J.; Spengler, J.; Chang, B.H.; Coultas, D.; Samet, J. (Harvard School of Public Health, Boston, MA). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Involuntary exposure to environmental tobacco smoke (ETS) has been implicated as a potential risk factor in development of several chronic diseases. However, misclassification of exposure may confound efforts to measure low level effects. The authors conducted an investigation into using biochemical markers to assess current exposure to ETS by comparing cotinine levels in body fluids to nicotine levels in air. Eighty-one, nonsmoking children carried personal monitoring pumps for two consecutive 24 hour periods to collect respirable suspended particles and airborne nicotine samples. Urine and saliva samples provided by the participants were analyzed by radioimmunoassay for cotinine. This paper examines the relationships among the children's cotinine levels and personal respirable particle concentrations, personal vapor phase nicotine concentrations and descriptive variables of passive cigarette smoke exposure.

22581 (DOE/ER/60493—1-Vol.2, pp 156-160) **Tobacco smoking and the indoor suspended particulate matter.** Revsbech, P.; Korsgaard, J.; Lundqvist, G.R. (Aarhus Univ., Denmark). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The indoor concentration and suspended particulate matter (SPM) was measured in 44 retrofitted and tight dwellings, which had electric cooking and were central heated and where the basic ventilation rate in median amounted 0.23 air changes per hour as measured with a tracer dilution method. The indoor concentration of SPM was in median 230 $\mu g/m^3$ with a strong correlation to the tobacco consumption (r/sub s/ = 0,716), but with no correlation to the frequency of airing or the basic ventilation rate. Tobacco smoking seems to be the main indoor source of SPM in contemporary dwellings. The importance of these findings is underlined by epidemiologic studies on passive smoking and health. Negative health aspects are therefore predictable for the non-smoking part of the population, living in homes with smoking family members.

22582 (DOE/ER/60493—1-Vol.2, pp 170-174) **Sidestream tobacco smoke constituents in indoor air modeled in an experimental chamber.** Vu Duc, T.; Huynh, C.K. (Univ. of Lausanne, Switzerland). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The natural dissipation of sidestream smoke was investigated from the standpoint of a static atmosphere in an experimental chamber and the rate of dissipation was expressed as the half-life of residence in the air derived from the kinetic equation of the first-order process. The calculated half-lives of total particulate matter, tar and nicotine were 3.7, 4.1 and 3.1 hours respectively. An overall half-life for polycyclic aromatic hydrocarbons from three to four rings was estimated to about less than 3 hours. Initial concentrations of the sidestream smoke constituents were calculated and contribution to ambient CO, total smoke matter and nicotine was found to be 0.8 ppm, 1.4 mg and 9.2 μg respectively per cigarette per m^3 volume. The results appeared consistent in day to day determinations under the experimental conditions.

22583 (DOE/ER/60493—1-Vol.2, pp 208-213) **Effects of house weatherization on indoor air quality.** Grimsrud, D.T.; Turk, B.H.; Prill, R.J.; Harrison, J.; Revzan, K.L. (Lawrence Berkeley Lab., CA). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2). Contract AC03-76SF00098.

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Forty Pacific Northwest existing homes were weatherized, including standard infiltration-reducing techniques, while before and after measurements of ventilation rates and indoor radon, formaldehyde, water vapor, nitrogen dioxide, carbon monoxide, and respirable suspended particle concentrations were conducted. Eight weatherized control homes were also monitored. Only radon and formaldehyde levels were elevated in some homes and were the result of high source-potential soils or interior finish materials. Standard weatherization practices resulted in a reduction of 15% in the specific leakage area from an initial average value of 5.9 cm^2/m^2. Indoor pollutant levels were only modestly affected and in some instances, radon concentrations were actually reduced due to the additional crawlspace ventilation installed as part of the weatherization process.

22584 (DOE/ER/60493—1-Vol.2, pp 218-224) **Harvard's indoor air quality respiratory health study.** Spengler, J.D.; Ware, J.; Speizer, F.; Ferris, B.; Dockery, D.; Lebret,E.; Brunnekreef, B. (Harvard School of Public Health, Boston, MA). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

This paper presents indoor air pollution data from 3 communities participating in a year-long health survey. Concentrations in homes, schools, and outdoors will be used to (1) derive exposure estimates for both indoor and outdoor pollutants for these children, and (2) develop regression models to predict exposures occurring in homes of children participating in the annual health survey. The air monitoring component measures concentrations of NO_2 and respirable size particulates.

22585 (DOE/ER/60493—1-Vol.2, pp 232-237) **Air pollution in museums, libraries and archives: sources, effects, and control.** Baer, N.S. (New York Univ., NY). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Indoor pollutants in museums, libraries and archives originate from the outgassing of building materials, air distribution by HVAC systems, emissions from artifacts themselves, and the activities of staff and visitors. In the absence of effective control, indoor pollution levels may approach and in some cases exceed outdoor levels. Damage observed includes the corrosion of metals, soiling of paintings, embrittlement of paper and leather, fading of textile and print dyes, development of microblemishes on microfilm and the loss of signal in recording media. Recently proposed air quality design criteria for heating, ventilation and air conditioning (HVAC) systems for cultural institutions are critically reviewed.

22586 (DOE/ER/60493—1-Vol.2, pp 238-241) **Performance of passive indoor air quality monitors in a multipollutant field study.** Hawthorne, A.R.; Matthews, T.G.; Dudney, C.S.; Vo-Dinh, T.; Spengler, J.D.; Mage, D.T. (Oak Ridge National Lab., TN). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2). Contract AC05-84OR21400.

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Passive sampling devices were used extensively to monitor indoor air quality in 70 homes in the Tennessee Valley area of the southeastern US. Monitored pollutants included radon, formaldehyde, nitrogen dioxide, polynuclear aromatic hydrocarbons, and water vapor as well as perfluorocarbon tracers used to measure average air exchange rates. Extensive replication of samplers were used in six of the study houses plus 5% to 10% replication in the remaining houses. Precisions observed generally ranged from 15% to 20% for the various passive monitors. Mean field blanks were low compared to indoor concentrations.

22587 (DOE/ER/60493—1-Vol.2, pp 242-246) **Continuous monitoring of air impurities in dwellings.** Keskinen, J.; Kulmala, V.; Graeffe, G.; Hautanen, J.; Janka, K. (Tampere Univ. of Technology, Finland). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Continuous monitoring of radon, air ions, CO_2 and aerosol particles was carried out over one week periods in 19 dwellings in the Tampere area. In addition to this, time-averaged particle mass concentrations in two size fractions were measured, and concentrations of certain organic gases and vapors were determined from short-time samples. Measured concentrations were in general relatively low irrespective of the location and despite the fact that the air exchange rates in small houses were usually found to be below 0.3 1/h. However, the average radon concentration (370 Bq/m^3) was relatively high. This is affected by the large fraction of small houses of all studied locations. Tobacco smoke was the only source producing particle concentrations that can be regarded significant.

22588 (DOE/ER/60493—1-Vol.2, pp 252-255) **Effects on perceived and measured air quality, health, absenteeism, and energy consumption, of installing openable windows in a sealed school.** Landrus, G.; Zuchowski, M.; Rosenzweig-Witherspoon, J.; Hunter, I. (Toronto Board of Education). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

To evaluate the effectiveness of installing openable windows in a previously sealed public school building, an interview/questionnaire study was conducted involving perceptions of staff and students, augmented by data for measured air quality, absenteeism, and energy costs. Staff members reported improved air quality, attributed fewer illnesses to the building, and expressed greater satisfaction with the building after the openable windows were installed. Students reported positively only that there were now enough windows. Correlations between perceived air quality and measured air quality were not significant. Absenteeism was not significantly related to the installation of the windows. Energy costs decreased slightly after the installation.

22589 (DOE/ER/60493—1-Vol.2, pp 256-261) **Indoor air quality within the home as a function of electric or gas end utilization.** Large, R.B. Jr. (Niagara Mohawk Power Corp., Syracuse, NY). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Over a period of three years, approximately 60 homes with various construction characteristics and heating systems were evaluated for air exchange rates, combustion pollution, formaldehyde, radon, and other pollutants. Pollutant types and levels were investigated as a function of a home's heating system and energy source. Because the research was done by an electric and gas utility which is privately owned, objective results, conclusions, and remedies could be obtained.

22590 (DOE/ER/60493—1-Vol.2, pp 262-266) **Simultaneous determination method of personal exposure levels for formaldehyde and nitrogen dioxide.** Matsumura, T.; Kametani, K.; Takeda, M.; Muramatsu, S. (National Institute of Hygienic Sciences, Tokyo, Japan). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

A study was made to learn the personal exposure levels of HCHO and NO_2 for various residential environments. For this work, a solid sorbent agent was used in ascertaining the personal exposure levels for HCHO and NO_2. HCHO and NO_2 were sampled in glass collection tubes (8 mm in diameter and 11 cm in length) at a flow rate of 0.1 L/min for 24 hours. The tubes were packed with a solid sorbent (silica gel coated with triethanolamine). The HCHO and NO_2 which were collected on the silica gel sampler were desorbed in deionized water and determined by using a spectrophotometer (HCHO:4-amino-3-hydrazino-5-mercapto-1,2,4-triazol method, NO_2:naphthyl ethylendiamine method). This method was applied to determine the personal exposure levels of HCHO and NO_2 in residences in general to be 0.007-0.025 ppm and 0.019-0.059 ppp, respectively.

22591 (DOE/ER/60493—1-Vol.2, pp 272-276) **Indoor air problems in different types of newly built dwellings.** van Dongen, J.E.F. (TNO Institute of Preventive Health Care, Leiden, Netherlands). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

In a number of Dutch housing projects the daily behavior of the occupants with respect to heating and ventilation has been investigated, as well as their judgment on indoor air and climate variables concerning (cigarette) smoke, (cooking) smells, vapor, mold, draught and temperature. It is shown that in a high number of the dwellings indoor problems exist, but it seems that these problems predominantly are not caused by lack of goal directed behavior of the inhabitants.

22592 (DOE/ER/60493—1-Vol.2, pp 277-282) **Field study of human exposure to benzo(a)pyrene in a community directly impacted by a foundry (preliminary results).** Waldman, J.M.; Lioy, P.J.; Harkov, R.; Greenberg, A. (Robert Wood Johnson Medical School, Piscataway, NJ). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

An on-going investigation of the total human exposure to an environmental pollutant is described. The study is being conducted in a community impacted by a foundry known to be the dominant local source of benzo(a)pyrene (BaP). The research aims to assess the relative contributions of indoor and outdoor sources and the measure BaP in all media. Preliminary results for indoor and outdoor measurements of inhalable particulate mass (IPM) are presented here. In several homes, indoor sources (e.g., cooking, cigarette smoke, a coal stove) lead to IPM levels much times higher than the ambient concentrations, although in homes without strong sources particles, IPM was lower than outdoor levels. However, nonparametric analysis disclosed the influence of ambient air quality on the daily fluctuations of indoor IPM in most cases.

22593 (DOE/ER/60493—1-Vol.2, pp 439-443) **Sick building syndrome in the office environment the Danish town hall study.** Skov, P.; Valbjoern, O. (Clinic of Occupational Medicine, Copenhagen, Denmark). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Measurements of the indoor climate were performed in 14 town halls in Greater Copenhagen, Denmark, together with a questionnaire study of 4369 employees in the town halls and 14 affiliated buildings. Sex, some personal characteristics, job related and psychosocial factors of work were significantly associated with the presence of work-related mucosal irritation and general symptoms. However, even controlled for these factors, the symptom prevalence differed highly between the individual town halls, giving support to the concept of using the term sick building syndrome.

22594 (DOE/ER/60493—1-Vol.2, pp 444-448) **Office building investigation.** Sterling, D.A.; Moschandreas, D.J.; Relwani, S.M. (IIT Research Institute, Chicago, IL). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

An investigation was initiated to identify the source of several environmentally related complaints and to recommend mitigation steps that would minimize or eliminate the complaints in an urban eight-story office building. Complaint (study) and non-complaint (control) work areas were studied in the course of the investigation. Environmental measurements implemented in segments of the work areas were: (a) air monitoring for carbon dioxide (CO_2), formaldehyde (HCHO), Volatile Organic Compounds (VOC), temperature, and relative humidity; (2) air exchange rate determination; (3) sensory (odor) evaluations; and (4) environmental perception questionnaires. It was concluded that there was no pronounced difference in measured pollutant concentrations or odors in the study or control areas. Air exchange rates were low in some study locations.

22595 (DOE/ER/60493—1-Vol.2, pp 482-486) **Building performance database: an analytical tool for indoor air quality research.** Collett, C.W.; Sterling, E.M.; McIntyre, E.D.; Steeves, J.F.; Weinkam, J.J. (Theodor D. Sterling Ltd., Vancouver, British Columbia). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The Building Performance Database (BPD) is an on-line collection of information which allows researchers to consolidate and search through large amounts of data from single or multiple buildings regarding such parameters as building materials, energy use, ventilation, lighting, acoustics, indoor air pollutant levels, and reported effects on the health and comfort of occupants. BPD provides architects, engineers, epidemiologists, hygienists, and building scientists with an interactive archival and analytical tool for research into door air quality and building performance.

22596 (DOE/ER/60493—1-Vol.2, pp 497-504) **Sick buildings - a phenomenon of internal information processing.** Knoetig, H.; Kurz, I.; Panzhauser, E. (International Organization for Human Ecology, Vienna, Austria). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

From the literature one may gain the impression that it is very difficult, or impossible, to grasp one distinct cause for all the different phenomena characteristic of sick buildings, in spite of the very intensive search for such a holistic causation. However, a common feature of all the attempts at an explanation to be found in the literature is the static approach used for this purpose, characterized by terms such as number of particles (of irritating substances) per unit of volume, number of stimuli per unit of time (referring to under- and overstimulation). Maybe a dynamic approach is useful, at least to a certain degree, when trying to appropriately describe and consequently solve the problem. One such dynamic approach can be provided by human ecology, especially through the General Inter-Action Scheme (G.I.A.S.). A respective hypothesis is presented.

22597 (DOE/ER/60493—1-Vol.2, pp 505-511) **Possible combined health effects in white collar workers caused by complex exposures.** Lercher, P.; Hoertnagl, J.; Kofler, W.W. (Universitaet Innsbruck, Austria). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Twenty-eight university-clerks were exposed to HCHO-concentrations (0,3 - 0,6 ppm) and other unfavorable characteristics of the indoor environment concerning noise, vibrations, thermal comfort, illumination for two years after removal. Very high prevalences of irritation of mucous membranes, skin and vegetative and neurobehavioral complaints occurred. Furthermore, a significance increase in sick leave incidences ($p = 0,01$) and sick leave days ($p = 0,05$) were observed during 6 quarters of a year after the removal, compared with 7 quarters before. Synergistic actions between HCHO and the other indoor climate determinants may have been important. This should be accounted for if limit values are set by national agencies to protect the health of the public.

22598 (DOE/ER/60493—1-Vol.2, pp 512-514) **Field study in three office towers in Quebec, Canada.** Nguyen, V.H.; Martel, J.G. (Institute de Recherche en Sante et en Securite du Travail, Montreal, Quebec). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The management and the unions of office workers in three separate office towers submitted a request to the Quebec Research Institute in Occupational Health and Safety to survey the quality of indoor air. In Montreal and in Quebec City there was a long history of complaints and illnesses typical of the symptoms of the tight building syndrome. The problem often occurred in the winter season, leading us to suspect that there was a lack of fresh outdoor air. A team decided to make a complete survey of the buildings, which consisted of the following: a questionnaire was distributed to all occupants of each of the surveyed buildings. The questions were conceived to help us establish their own perceptions of the quality of indoor air; biological monitoring was performed in order to obtain and quantify all the biological agents present in the ventilation systems and in the offices; an environmental survey of possible chemical agents was performed; an investigation of the amount of fresh outdoor air introduced into the buildings was carried out; a study of the HVAC system performance; and a series of comfort measurements including room temperature, humidity, air motion.

22599 (DOE/ER/60493—1-Vol.2, pp 520-524) **Occupant assessment of the indoor environment.** Rohles, F.H. Jr.; Woods, J.E.; Morey, P.R. (Kansas State Univ., Manhattan). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Twelve features of the indoor environment representing the thermal, acoustical, lighting and air quality constituents were rated according to their percentage contribution to the quality of the indoor space by 111 advanced engineering students and 89 clerical workers. The resulting mean percentages were: temperature, 15.8; brightness of the lighting, 11.0; tobacco smoke, 9.8; loudness of the sound, 8.7; noisy distractions, 8.5; lighting glare, 7.9; odor, 7.5; air movement, 7.2; humidity, 7.1; dust, 6.7; shadows, 5.1; and pitch, 4.7. These percentages will serve as loadings for the 12 individual scale items in which each item will be rated on a 6 point acceptability scale ranging from 1, very unacceptable to 6, very acceptable.

22600 (DOE/ER/60493—1-Vol.2, pp 537-541) **Air quality in a sick library over a period of 16 weeks.** Berlund, B.; Berglund, U.; Linvall, T.; Lundin, L. (Univ. of Stockholm, Sweden). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Over 16 weeks the exhaust air from a library was repeatedly sampled and analyzed for volatile organic compounds by a GC/MS/SD technique and by the method of magnitude estimation. The concentration range for nine selected compounds (2-butanone, 1-butanol, toluene, 2-ethylcyclobutanol, tetrachloroethylene, n-butylacetate, m- and p-xylene, o-xylene) was between 0.2 and 60 $\mu g/m^3$ and toluene was the only compound that had the same pattern of variation over time for both concentration and odor intensity. The data showed a high split-half reliability both for chemical and sensory measurements of parallel samples. A negative correlation between the relative humidity (25.5-30.5%) and the concentration of four typical indoor compounds was found. This relationship differed significantly from the relationship obtained for compounds that appear both indoors and out.

22601 (DOE/ER/60493—1-Vol.2, pp 557-561) **Cure of a sick building: a case study.** Helsing, K.J.; Billings, C.E.; Conde, J. (Johns Hopkins School of Hygiene and Public Health, Baltimore, MD). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Following allegations that faculty and students were being poisoned by high levels of CO and CO_2 in a five-year-old school, a multidisciplinary study was initiated to assess (1) available records of health and academic achievement of students, (2) actual levels of CO and other contaminants in the air, and (3) measurable ventilation characteristics of classrooms. No excess absenteeism, illnesses, or lack of academic achievement were found, nor were any significant levels of CO, HCHO, or SO_2 found. However, there was insufficient fresh air supply to some classrooms, and a large percentage of students exhibited classic symptoms of sick building syndrome, i.e. headache, eye burning, and fatigue. Correcting the ventilation problems resulted in a reduction of symptoms to approximately equal those of students in other schools in the county.

22602 (DOE/ER/60493—1-Vol.2, pp 562-565) **Gaseous pollutants in a new office building.** Konopinski, V.J. (Indiana State Board of Health, Indianapolis). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The owner of a new single story office building under construction agreed to participate in a study to characterize indoor air quality in the new building. The formaldehyde from wood products was measured to be 0.01 to 0.2 ppm inside. Carbon dioxide was measured at 400 to 900 ppm. Organic solvents were nondetectable to a trace, less than 1 ppm. There was no detectable formaldehyde in the outside air. Carbon dioxide in the outside air varied from 200 to 400 ppm. Minimal indoor gaseous contaminants were detected during construction with increased concentrations during occupancy. The formaldehyde concentration followed a seasonal variation after the first year and also exhibited definite decay.

22603 (DOE/ER/60493—1-Vol.2, pp 582-586) **Health complaints, CO_2 levels and indoor climate in Dutch schools.** Potting, J.; van de Sandt, P.; Romeny-Wachter, I.; Brunekreef, B.; Boleij, J.S.M. (Agricultural Univ. Wageningen, Netherlands). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

An epidemiological study has been carried out in 3 schools with health complaints reported by teachers (cases) and 4 schools without these complaints (controls) to assess the relationship between the prevalence of complaints of children and CO_2 level and indoor climate. The complaints included symptoms like headache, eye irritation and fatigue. The results of indoor climate measurements reflected common situations without extremes. The CO_2 levels were in all classrooms extremely high. The Dutch standard for schools (1200 ppm) was exceeded during 27% to 97% of the school time. No relationship was found between the prevalence of complaints and being a case or control school or the CO_2 level. A relationship was found between the CO_2 level and the complaint bad odor of the air. There was no relationship between being a case or control school and the CO_2 level.

22604 (DOE/ER/60493—1-Vol.2, pp 598-602) **Potential pollutants - their importance to the sick building syndrome - and their release mechanism.** Nielsen, P.A. (Danish Building Research Institute, Hoersholm). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

In the Danish Town Hall Study, where the goal is to find the factors of parameters influencing the SBS, the importance of the potential pollutants has also been examined. The research project comprises approx. 3.500 persons and 14 office buildings. More than 30 different factors or parameters have been measured and registered. The factors comprise, among other things, temperatures, air humidity, change of air, VOC, formaldehyde, particles, and microorganisms. The possibility of potential pollutants was the factor with the highest correlation coefficient to mucosal irritation. The possibility of potential pollutants have been described on the basis of amount of fleecy surfaces, the number of shelves and cleaning program, cleaning agents and methods. Furthermore, the hypothesis/theory forming the basis of the emission of pollution to the indoor climate is mentioned in the paper.

22605 (DOE/ER/60493—1-Vol.2, pp 610-614) **Irritant effects of formaldehyde in mobile homes.** Liu, K.S.; Huang, F.Y.; Hayward, S.B.; Wesolowski, J.J. (California Dept. of Health Services, Berkeley). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

This paper reports a cross-sectional study of health problems associated with formaldehyde exposure in California mobile homes. Week-long integrated formaldehyde concentrations were measured using passive monitors while the residents continued their normal activities in their households. Information on demographic variables, smoking behavior, respiratory diseases and physical symptoms was acquired on over 1000 individuals. Formaldehyde concentrations measured from under the limit of detection (0.01 ppm) to 0.46 ppm. The relations between physical symptoms and formaldehyde exposure were analyzed using a logistic regression procedure. Irritant effects were found to be associated with formaldehyde exposure after controlling for age, sex and smoking. Even stronger associations between formaldehyde concentrations and certain symptoms were found among people with chronic health problems.

22606 (DOE/ER/60493—1-Vol.2, pp 630-634) **Investigation study between air contamination and odor sensation in the office building.** Minamino, O. (Shibaura Institute of Technology, Tokyo, Japan). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The author carried out the measurement on air contamination (carbon dioxide and dust concentration) in a room where smoking was banned or nobody is smoking. From the data collected, we attempted to pursue co-relation between carbon dioxide concentration and odor sensation felt by subjects and panels respectively. In this experiment, the following information was obtained in our effort to ascertain the outdoor air supply. We used five lecture rooms in two different colleges and one lecture-hall in the office building. When the quantity of outdoor air supply is determined similarly as reported before with the panels(visitors) as objects and references are set on slightly clean in the dirty sensation, smell in the odor sensation and slightly discomfort in the discomfort odor sensation, it becomes substantially 5-10 m^3/hour, person.

22607 (DOE/ER/60493—1-Vol.2, pp 635-639) **Measurement of carbon dioxide of the indoor air to control the fresh air supply.** Fecker, I.; Hangartner, M.; Wanner, H.U. (Federal Institute of Technology, Zuerich, Switzerland). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

In order to save energy, i.e. ventilation heat losses, the fresh air change rate should be adapted to the prevailing need. Even though it is a fact, that reducing the fresh air change rate will result in a ventilation heat gain, the fresh air flow rate should not be kept too low, so that pollutants, humidity and body odor can accumulate. The results of measurements in a climatic chamber and in a lecture theater show a significant relationship between temperature, concentration of carbon dioxide and body odor of the indoor air under nonsmoking conditions. The upper limit of carbon dioxide, where the indoor air quality is still acceptable to persons entering a room, is between 0.1% and 0.15% vol, whereas for occupants in the room this limit may be set higher because of adaptational effects.

22608 (DOE/ER/60493—1-Vol.2, pp 640-644) **Ventilation and background odor in offices.** Lauridsen, J.; Muxhaxheri, M.; Clausen, G.H.; Fanger, P.O. (Technical Univ. of Denmark, Lungby). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Ventilation standards assume that the occupants are the major polluters in offices and conference rooms. In the present field study 49 judges (visitors) evaluated the odor intensity, air freshness and acceptability of the air in 15 different offices and 5 conference rooms at three different occasions: (a) with no mechanical ventilation and no occupants, (b) with mechanical ventilation and no occupants, and (c) with mechanical ventilation and with occupants. Preliminary results imply that the background odor is an important characteristics of indoor air quality. It should be taken into account by modeling ventilation requirements.

22609 (DOE/ER/60493—1-Vol.2, pp 655-660) **Psychophysics of formaldehyde odor.** Berglund, B.; Berglund, U.; Hoegman, L.; Johansson, I.; Lindvall, T. (Univ. of Stockholm, Sweden). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The sources for the variance of detection thresholds for formaldehyde were researched. The results showed that the two generation methods, headspace of para-formaldehyde or a solution of formaldehyde and water stabilized with sodium hydroxide, had no or very little effect on the odor sensation of formaldehyde. The absolute odor threshold was always in the region of 135-220 $^{+}$ g/m^3 (50 observers; 6 experiments). For a period of one year, the odor detections and the perceived odor intensities (group data) were consistent. The validity of the psychophysical methods of constant stimuli and magnitude estimation was demonstrated by the fact that the zero level of the detections agreed with the subjective zero for the perceived intensity. This occurred between 10-30 $^{+}$ g/m^3 formaldehyde.

22610 (DOE/ER/60493—1-Vol.2, pp 666-670) **Sources and concentrations of aldehydes and ketones in indoor environments in the UK.** Crump, D.R.; Gardiner, D. (Dept. of the Environment, Hertfordshire, England). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Individual aldehydes and ketones can be separated, identified and quantitatively estimated by trapping as the 2,4-dinitrophenylhydrazine (DNPH) derivatives and analysis by HPLC. Appropriate methods and detection limits are reported. Many sources of formaldehyde have been identified by this means and some are found to emit other aldehydes and ketones. The application of this method to the determination of the concentration of these compounds in the atmospheres of buildings is described and the results compared with those obtained using chromotropic acid or MBTH.

22611 (DOE/ER/60493—1-Vol.2, pp 676-681) **Formaldehyde: a case study.** Howlett, C.T. Jr.; Newton, L.R.; Stevens, K.R. 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Formaldehyde presents a unique case study for consideration of the complex issues that need to be addressed in the indoor environment. A wide range of factors can affect formaldehyde levels which present challenges and dilemmas for the development of regulatory programs to address the issue of ensuring that acceptable concentrations are found in the indoor environment. Cigarettes may be the most significant source of indoor formaldehyde concentrations. The construction materials industry has reduced formaldehyde emissions substantially, with a reduction in complaints about sensory irritation. The product emission standards have proven effective and are enforceable. These standards assume minimum ventilation rate. Ventilation requirements should be established as an integral part of a comprehensive indoor air quality control program.

22612 (DOE/ER/60493—1-Vol.2, pp 682-685) **Air and water analysis of formaldehyde and of other aldehydes.** Keller, R.; Huempel, P. (Universitaet zu Luebeck, Germany, F.R.). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

A method is described for the determination of the smallest quantities of formaldehyde, acetadehyde, propionaldehyde, furfurol, glutardialdehyde, hexanale, butyraldehyde, acrolein and benzaldehyde in air and water. The sampling our of the air takes place via absorption in watery solution, respectively, by adsorption onto silica gel. The aldehyde dissolved in water is determined by means of the external standard method. The aldehyde is chromatographically determined with the aid of 2,4-dinitrophenylhydrazine (2,4-DNP) in solution. The detection limit in air amounts to 4 μg of formaldehyde/m^3. The detection limit in water amounts to 2 mg CH_2O/1.

22613 (DOE/ER/60493—1-Vol.2, pp 686-689) **Formaldehyde sensitivity and control.** Konopinski, V.J. (Indiana State Board of Health, Indianapolis). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The Division of Industrial Hygiene and Radiological Health, Indiana State Board of Health, investigated a case of suspected formaldehyde sensitivity in mid 1985 and acquired data until December 1986. Initial measurements showed formaldehyde concentrations of 0.03 to 0.05 ppm with the major source being a three section bookcase. Removal of the bookcase from the residence, ammonia treatment of the books and ventilation of the residence have lowered the formaldehyde concentration to 0.01 to 0.02 ppm. Symptom severity and frequency of the affected female resident have subsided 85 to 90%. This case illustrates that some persons can be affected adversely by airborne formaldehyde concentrations well below 0.1 ppm.

22614 (DOE/ER/60493—1-Vol.2, pp 690-694) **Formaldehyde injuries in prefabricated houses: causes, prevention and reduction.** Marutzky, R. (Fraunhofer Institute for Wood Research, Braunschweig, Germany, F.R.). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Particle boards are dominant building materials for prefabricated houses. Due to the fact that most panels are bonded with formaldehyde containing resins the large area use of these materials can cause serious injuries to the health of residents. Results of measurements in different prefabricated houses demonstrate the development from former building types with high formaldehyde concentration levels to new building types with low concentration levels. Possibilities to reduce formaldehyde injuries by sealing and chemical treatments are discussed.

22615 (DOE/ER/60493—1-Vol.2, pp 695-699) **Variations of formaldehyde exposure in homes and office buildings.** Meyer, C.B.; Endroedy, E.; Sundin, B.; Mansson, B. (Lawrence Berkeley National Lab., CA). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Indoor air formaldehyde levels undergo temporal and spatial variations. This causes significant differences in formaldehyde exposure of people who share buildings. This paper considers the effect

of building products and furniture on the total formaldehyde exposure of homemakers and office workers. The recent development and implementation of standard material test methods, and the development of correlations between these tests and formaldehyde indoor air levels have made it possible to predict formaldehyde exposures, and to prevent or correct undesirable formaldehyde indoor air exposure levels due to emissions from wood paneling.

22616 (DOE/ER/60493—1-Vol.2, pp 705-708) **Convenient method for determination of sub-ppb to ppm levels of C_1-C_6 aldehydes in air by solid adsorbent sampling.** Stray, H.; Oehme, M. (Norwegian Institute for Air Research, Lillestroem). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Sep-PAK C_{18} cartridges impregnated with 2,4-dinitrophenylhydrazine (2,4-DNPH) and phosphoric acid were used for the sampling of C_1-C_6 - aldehydes in air. After sampling the formed hydrazones were extracted with acetonitrile and separated by high performance liquid chromatography (HPLC). Blank values were normally lower than 50 ng/sampling tube. The sampling speed of 0.5-1.5 l/min and sampling periods of up to 24 hours allow to determine concentrations from 0.1 ppb to several ppm. When two sampling tubes were used in series, 95 +/- 3% (n = 50) of the formed hydrazones were found on the first cartridge.

22617 (DOE/ER/60493—1-Vol.3, pp 15-19) **Evaluation of indoor air pollution and its effect on human health and Beijing rural areas.** Hu, H.S.; Liu, Y.C. (Beijing Medical Univ., China). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Average exposures to SO_2, RP, NO_2 and CO during the summer and winter of 1986 were monitored in 24 new and old village households in the northern suburb of Beijing and 600 school children were measured and observed for their chronic and acute respiratory symptoms and illness, pulmonary function, immune responses, carboxyhemoglobin level and responding time of eye sight to signals so as to evaluate the effect of rural indoor air pollution on human health. The results of air monitoring data and some health outcomes suggests that mean exposures of children in the new village were significantly lower than in the old village with a sign of improved health. The implications of different house design, cooking and heating systems and passive smoking and the need for further research are discussed.

22618 (DOE/ER/60493—1-Vol.3, pp 30-33) **Personal, indoor and outdoor NO_2 measurements in Korea.** Kim, Y.S.; Yanagisawa, Y.; Zong, M.S. (Hanyang Univ., Seoul, Korea). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

A pilot study on indoor air concentrations of nitrogen dioxide (NO_2) was undertaken in the Seoul area, Korea during February-April 1986. Indoor and outdoor data on nitrogen dioxide concentrations were obtained for 48 private residences. Personal exposure to NO_2 was also investigated. Indoor/outdoor ratio of NO_2 concentrations was 0.87, while the correlations between the indoor and outdoor levels were less than 0.50 for NO_2. Homes with a unvented space heater had average living room NO_2 concentrations approximately double those with a vented space heater. Residences with smokers had significantly higher living room NO_2 levels than those without smokers.

22619 (DOE/ER/60493—1-Vol.3, pp 34-39) **Cultural, technological, and environmental factors influencing indoor air pollution in rural India.** Ramakrishna, J. (East-West Center, Honolulu, HI). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

This paper presents the results of a year-long study of indoor air pollution in one north and two south Indian villages where diet, cooking practices, and kitchen structure and location differ markedly. Measurements of TSP exposures to the cook show that smoke reduction attained by improved smokeless cook stoves is limited and the difference between old and new stoves is statistically significant only in the south. TSP exposures averaged 1.6-3.5 mg/m^3; the lowest recorded exposures were of cooks in the south using old stoves fitted with hood-like chimneys. Carbon monoxide concentrations averaged 6.2-27 mg/m^3 and were high enough to be of concern only in some older, less ventilated houses in the south. The paper also discusses the roles played by fuel type, cooking process, and kitchen characteristics in determining exposure.

22620 (DOE/ER/60493—1-Vol.3, pp 40-44) **Indoor exposure to auto exhaust pollution on urban street canyon in a less developed country: India.** Aggarwal, A.L.; Chatterjee, S.K. (National Environmental Engineering Research Institute, Nagpur, India). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Road side residents and shop-keepers are exposed to high concentrations of auto-exhaust pollutants in India because the tropical climate forces them to keep doors/windows open. The formation of such canyons of high pollution pockets are due to poor road capacity, mixed nature of the traffic flow and poorly maintained automobiles which are low fuel efficient. A detailed cross-sectional study undertaken in Ahmedabad showed that at certain corners the indoor exposure to CO, Pb and NOx was exceeding the respective permissible levels causing a statistically significant rise in COHb, B-Pb and U-Pb levels and a drop in lung health when compared with the control group.

22621 (DOE/ER/60493—1-Vol.3, pp 45-49) **Indoor air quality in India.** Mishra, U.C. (Bhabha Atomic Research Centre, Bombay). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Indoor air quality in a tropical country like India is governed by factors which are different from those of the temperate cold countries. These differences are largely in the climate, type of houses and cooking fuel. Studies reported in this paper include measurement of indoor radiation levels primarily due to radon and its daughters and of gaseous pollutants and suspended particulate matter. The results have been interpreted in terms of ventilation rates, levels of natural radioactivity in ambient environment and the type of cooking fuel used. Dwellings constructed with coal fly-ash bricks obtained as waste material from the thermal power stations have also been investigated where the levels of natural radiation have been found to be higher by factors of 2-4. The survey covers Bombay and a few other stations. None of the areas show radiation exposures close to working levels. The main source of indoor pollution in India is cooking fuel.

22622 (DOE/ER/60493—1-Vol.3, pp 50-54) **Indoor air quality in the Maragua area, Kenya.** Boleij, J.S.M.; Ruigewaard, P.; Hoek, F.; Thairu, H.; Wafula, E.; Onyango, F.; de Koning, H. (Agricultural Univ., Wageningen, Netherlands). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

In the framework of a study on acute respiratory infections in Kenya repeated 24 hour average measurements of respirable suspended particles (RSP) and nitrogen dioxide (NO_2) were carried in 36 houses where most of the cooking was done on open fires using firewood as fuel. In 3 houses hourly measurements were made between 6 a.m. to 10 p.m. to observe the daily pattern. The mean of

the 24 hour average RSP and NO_2 levels was 1400 $\mu g/m^3$ and 90 ppb respectively. Particularly the RSP levels indicate that health effects due to excessive exposure to smoke from biomass combustion are likely to occur. Analysis of variance showed little or no correlation between pollution levels and house characteristics. Also very homogeneously distributed concentrations were found among the houses. This corroborates the observation that no relation could be detected between ARI incidence and pollution levels or housing characteristics. To draw such conclusions a subgroup with lower exposure levels would have to be included in the study.

22623 (DOE/ER/60493—1-Vol.3, pp 57-61) **Indoor-outdoor relationship of total suspended particulate and inhalable particulate matter in Teheran, Iran.** Aghdaie, N. (Materials & Energy Research Centre, Teheran, Iran). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The objective of this study was to evaluate the suspended particulate levels indoors and outdoors. Selected site was air quality monitoring laboratory in air pollution division of Materials & Energy Research Centre (M.E.R.C.) in Teheran, Iran. The total suspended particulate matter (TSP) samples were taken by high-volume air sampler. The inhalable particulates (IP) both indoor and outdoor were evaluated by Anderson cascade impactor simultaneous with TSP. The arithmetic mean concentration of TSP for outdoor was 265 $\mu g/m^3$ and for indoor 142 $\mu g/m^3$. The average IP for samples taken outdoor was 180 $\mu g/m^3$ while the average of indoor was 121 $\mu g/m^3$. The range of indoor-outdoor ratio for TSP and IP was 0.3-0.9 was 0.4-1.0 respectively. The average mass median diameter of IP indoor was 1.57 μm and for outdoor was 3.04 μm. It is concluded that a person remaining indoor probably is exposed to about 68% of outdoor inhalable particulates, and therefore it is appropriate to consider both indoor and outdoor exposure when establishing air quality standards.

22624 (DOE/ER/60493—1-Vol.3, pp 68-72) **Particulate and gaseous pollutants in residences in Nepal.** Davidson, C.I.; Pandey, M.R. (Carnegie Mellon Univ., Pittsburgh, PA). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Concentrations of several air pollutants were measured in single-family houses at elevations of 1300-3900 m in Nepal. Information was also obtained on biomass fuel use by each household, physical characteristics of the houses, and emission factors for biomass combustion. The measured concentrations were compared with those calculated using a one-compartment mass balance model; results showed rough agreement for many of the species despite uncertainties in values of the model input parameters.

22625 (DOE/ER/60493—1-Vol.3, pp 73-76) **Combustion gases: sources, characterization and health effects.** Fouldirad, J. (Ministry of Health and Medical Education, Teheran, Iran). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The temperature in cold parts of Iran is around minus 15.C to minus 20.C or sometimes lower with heavy snow falls causing communications to be cut off. The people use stoves, Korcy, cooking stoves, local ovens, and gas heaters as sources of energy. The characterization of each of above sources and the combustion of fuels are different. Natural and mechanical ventilation, carbon monoxide, particulates (smoke-soot), microbiological hazards and tobacco smoking (active and passive smoke) are the main health effects.

22626 (DOE/ER/60493—1-Vol.3, pp 77-83) **Indoor air quality in offices and hospitals in high-altitude Himalaya.** Gadgil, A. (Tate Energy Research Institute, New Delhi, India). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Indoor air-borne concentrations of total suspended particulates (TSP) and CO are measured in several offices, hospital rooms and hospital wards in high altitude Himalaya (3500 m above MSL). It is found that emissions significantly depend on whether the local coal-fired space heaters are vented from the room with a straight chimney or through a chimney shaped like an inverted L. CO levels found in hospital and offices exceed in several instances concentrations at which healthy adults would experience CO poisoning even at sea level. Possible remedies for alleviating the problem are discussed.

22627 (DOE/ER/60493—1-Vol.3, pp 84-89) **Studies on environmental aspects of cook-stoves.** Jindal, S.; Parsad, R. (Centre for Rural Development and Appropriate Technology, New Delhi, India). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Biomass burning cook stoves are the main source of domestic pollution. Carbon monoxide, suspended particulates & benzopyrene are the main pollutants due to combustion of biomass. To improve the thermal efficiencies many designs of improved cook stoves have come up. An attempt is being made to evaluate & compare the emissions of these pollutants in improved & traditional cook stoves & their impact on indoor air quality. It is observed that the formation of CO is greater in improved cook stoves while TSP & benzo(a)pyrene are quite reduced in a simulated village kitchen (SVK) air.

22628 (DOE/ER/60493—1-Vol.3, pp 95-99) **Mechanism of smoke generation in coal-fired chulha and its means of elimination.** Mandal, A.; Prasad, R.; Guha, B.K.; Sarkar, M.K. 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

In India soft coke and wood are the major solid fuels used for cooking purposes. Soft coke is used mainly in urban areas, whereas, wood is used in the rural areas. The coke is burned in a household appliance, commonly known in India as a sigri or a chulha. Intense smoke pollution, generated during the lighting operation is the largest drawback of using such an appliance in populated areas. A systematic study of combustion in a household model of a chulha was conducted primarily to design the mechanism of smoke generation in such combustion processes, so that a possible solution to this problem could be obtained.

22629 (DOE/ER/60493—1-Vol.3, pp 100-104) **Some aspects and prospects of indoor aeromycoflora from India.** Manoharachary, C.; Saibaba, M. (Osmania Univ., Hyderabad, India). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

A review concerning the mycological aspects of indoor environments that are worked out in India, its status and its future prospects has been presented. It also highlights the data (1985-1986) pertaining to fungal spores associated with some selected houses of patients suffering with allergy in Hyderabad, India. Standard methods were employed in analyzing the mycoflora associated with the indoor environments of houses. Patients have shown positive reactions to the clinical tests and immunization treatments. Out of 33 fungal spore types identified in this study, 14 fungal spore types were aeroallergenic.

22630 (DOE/ER/60493—1-Vol.3, pp 105-109) **Studies on the components of air borne dust particles indoors in a Secunderabad railway station and a mess hall.** Raza, S.H.; Nirmala, B.; Murthy, M.S.R. (Osmania Univ., Hyderabad, India). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The paper reports the estimates of dust fall and its chemical composition in a Hyderabad viz. Secunderabad Railway Station and a big domestic mess hall. The amount of dust fall, percentage of living matter in aerosols, pH, SO_4, Cl, Fe, Co, Zn, Mn, and Cu contents of dust were analyzed. The concentration of air borne dust particles was 3.06 to 5.40 g/m²/month in the railway station whereas in the mess hall it was 1.86 to 2.9 g/m²/month. A relationship between size and concentration of dust was drawn.

22631 (DOE/ER/60493—1-Vol.3, pp 110-114) **Studies on atmospheric fungi of some indoor environments (India).** Saibaba, M.; Manoharachary, C. (Osmania Univ., Hyderabad, India). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The present investigation reports the comparison of the various biopollutants in different indoor environments - vegetable market, green house, dwelling houses, poultry sheds, library buildings and hospital wards. Altogether 81 fungal spore types were collected by using conventional Rotorod samplers and Tilak's volumetric spore trap. The spore types were classified into four categories on the basis of their origin in indoor environments i.e., (i) plant pathogenic (ii) animal pathogenic (iii) aero allergenic and (iv) book deteriorating spore types.

22632 (DOE/ER/60493—1-Vol.3, pp 115-120) **Difficulties in achieving and verifying exposure reductions in village households with improved biofuel-fired cook stoves.** Smith, K.R.; Durgaprasad, M.B. (East-West Center, Honolulu, HI). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Personal TSP exposure experienced by village cooks and near-stove CO concentrations in households using four types of improved stoves were compared to levels in nearby households using the same biofuels in traditional stoves without flues. Measurements were taken during 120 cooking periods in 93 households of 10 villages in western India over a 5-week period in early winter. TSP exposures, which averaged 2.2-8.7 mg/m³ during the cooking period, were not statistically lower for cooks using improved stoves with flues. CO concentrations, which averaged about 45-120 mg/m³ for traditional stoves, on the other hand, were apparently lower by a factor of three. Two principal conclusions are that, in these conditions, indoor area monitoring is not a useful indicator of exposures and that indoor conditions can be greatly affected by outdoor concentrations.

22633 (DOE/ER/60493—1-Vol.3, pp 123-128) **Investigations on IAW and subjective evaluations of occupants for indoor environments in Japanese office buildings.** Komine, H.; Yoshizawa, S.; Tochihara, Y.; Kimura, E.; Ohnaka, T. (Institute of Public Health, Tokyo, Japan). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The investigations on IAQ and the subjective evaluation of the occupants for the indoor environments were conducted in 70 Japanese office buildings during the summer in 1986. All of the investigated buildings had air conditioning systems though some of them were not central systems. All buildings but one in Sapporo operated the systems on the day of investigation. The findings are that (1) some difference exists between IAQ in specially designated buildings in the law and that in the buildings without designation; (2) the occupants in some office buildings similar health complaints to the sick building syndrome as defined by WHO; and (3) there are good correlations between the occupants evaluations for the indoor environments and the measured data of the environmental factors.

22634 (DOE/ER/60493—1-Vol.3, pp 129-134) **Automatic measurement and data collection system on indoor air study at three small housing flats.** Savolainen, T.; Raunemaa, T.; Wellman, K. (Univ. of Kuopio, Finland). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The impact of three different ventilation systems on the indoor air of three similar housing flats is investigated in this study. Each house has six apartments. The ventilation systems are: natural ventilation due to gravity, mechanical exhaust ventilation and mechanical supply and exhaust ventilation. The computer controlled data collection system takes care of the ventilation rate, relative humidity and temperature measurements in indoor air and weather measurements outdoors. The ventilation efficiency depends mainly on the habits of the tenants. The mean ventilation coefficients of the houses were between 0.1-0.8 ac/h. Great daily variation was observed in the data. The relative humidity indoors had a negative correlations to the ventilation.

22635 (DOE/ER/60493—1-Vol.3, pp 135-137) **Improving occupant well-being with ionized air.** Jokl, M.V.; Rohles, F.H. (Technical Univ., Prague, Czechoslovakia). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The reason for contradicting results during experiments with the influence of lightweight aeroions on man may be: (a) masking effect of the other constituents of environment, (b) winding up of aeroions by the ionizer alone or by the air conditioning system. Respecting these facts, the positive influence of lightweight aeroions on man can be proven. The results of an experiment with 100 subjects working in a cigarette production plant are presented.

22636 (DOE/ER/60493—1-Vol.3, pp 138-141) **Airborne and settling particulates in a day-care institution.** Lundqvist, G.R.; Aalykke, C. (Univ. of Aarhus, Denmark). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The preventive measure of reducing exposure to airborne viable particles such as bacteria and fungi is partly to remove or reduce the sources and to use dilution ventilation with clean air. However, ventilation rates in modern energy-efficient buildings without mechanically ventilation and a tight building envelope may have natural infiltration rates well below 0.5 air change per hour (ACH). Even in mechanically ventilated institutions may ventilation rates normally be lower than or equal to 4 ACH, which means that most large particles will settle out before they are removed to the air outlets. Detection and quantification of viable particulates in settled dust should therefore always supplement the taking of air samples during investigations of indoor contamination levels.

22637 (DOE/ER/60493—1-Vol.3, pp 142-146) **Detailed study of the effects of ventilation, filtration and outdoor air on the composition of indoor air at a telephone office building.** Weschler, C.J.; Shields, H.C. (Bell Communications Research, Red Bank, NJ). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Sensors installed at a telephone office building in Neenah, WI continuously monitor twenty-four parameters related to the operation of the building's heating, ventilation, and air conditioning (HVAC) system. This data is stored in a dedicated minicomputer and can be retrieved, in various formats, for subsequent analyses. For more than a year we have conducted detailed chemical analyses of indoor and outdoor samples collected at this same location. Using the above data, we have examined the composition of the indoor air as it correlates with the composition of the outdoor air and the various HVAC operating parameters.

22638 (DOE/ER/60493—1-Vol.3, pp 147-151) **Quantitative method for measuring air recirculation.** Ancker, K.; Goethe, C.J.; Bjurstroem, R. (Dept. of Occupational Medicine, Stockholm, Sweden). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

There are both technical and medical-hygienic needs of accurate and useful methods to measure air recirculation in ventilation systems. This is possible by analysis of the CO_2-concentrations in outdoor air (C_1) and at two well-defined points before (C_2) and after (C_3) the mixing point for recirculated and fresh air. The percentage of recirculated air in the mixed inlet air to the interior of the building is represented by the quotient 100 x $(C_3-C_1)/(C_2-C_1)$. The accuracy of the method is excellent when the CO_2-concentrations are determined with a sensitive instrument, such as an IR-spectrophotometer. However, detector tubes for CO_2-analysis obtainable on the market today are not usable in this situation. Air recirculation in peopled spaces could result in CO_2-concentrations in the inlet air which are considerably higher than 500 ppm.

22639 (DOE/ER/60493—1-Vol.3, pp 157-161) **Minimum ventilation rates and ventilation strategies.** Trepte, L.; Le Marie, A. (Dornier System GmbH, Friedrichshafen, Germany, F.R.). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The ventilation of dwellings is essential for the removal of chemical contaminants, indoor pollutants as carbon dioxide, body odor, and water vapor. At the same time it effects comfort and energy consumption for space heating. The main sources of contaminants giving rise to health effects in dwellings were found to be tobacco smoke, some building materials and under certain conditions, combustion appliances. For indoor pollutants being most important within the work of International Energy Agency's Annex IX Minimum Ventilation Rates air exchange rates have been defined which prevent (1) damage to the health of occupants, (2) annoyance or reduction in amenity, and (3) damage to the building fabric. Technical solutions which can meet the controverse requirements for good indoor air quality and energy conservation have to integrate the following aspects: (1) tight building's envelop, (2) mechanical ventilation with the possibility to adapt outdoor air supply to demand, (3) inhabitants behavior fitting these requirements and acceptance of the technology by the inhabitants, (4) heat recovery, and (5) an important key to economical solutions: design and realization of ventilation systems of high efficiency.

22640 (DOE/ER/60493—1-Vol.3, pp 180-186) **Ventilation by demand.** Drangsholt, F. (SINTEF, Trondheim, Norway). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

In buildings where the main source of pollution comes from people, CO_2 from respiration can be used as an indication of the air quality. This paper considers the potential savings which can be made when the amount of fresh air is controlled in accordance with the measured concentration of CO_2 in the occupation zone. The paper also discusses some of the practical problems connected with the introduction of this type of control strategy.

22641 (DOE/ER/60493—1-Vol.3, pp 187-192) **Characteristics of concentration changes in a clean room.** Fujii, S.; Boelman, E.C. (Tokyo Institute of Technology, Japan). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

This paper discusses a set of experiments aimed at investigating the influence of various parameters upon the characteristics of particulate concentration changes in a conventional airflow clean room. Indoor particulate concentration decrement factors were determined for various locations and used to determine the time needed for concentration to stabilize and the particle removal efficiency at each location.

22642 (DOE/ER/60493—1-Vol.3, pp 193-197) **Use of tracer gas and analytical models to study dilution and recirculation from laboratories.** Georgakis, K.S.; Smith, J.W.; Goodfellow, H.D. (Univ. of Toronto, Ontario). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

A tracer technique for estimation of dilution and recirculation of the exhaust gases was developed and applied in tests conducted at two major laboratory buildings. The results of the tests demonstrated the great dependence of dilution and recirculation upon factors such as wind speed and direction, vent-to-intake distance, and stack height. The tracer data were also used to validate several analytical models predicting the minimum dilution. Although none of the models was outstanding relative to the others, the one accounting for the extra dilution caused by the stack height gave particularly good predictions. Finally, a model developed in the present study proved that the Gaussian diffusion equation can provide reasonable estimates of dilution around buildings, provided that the appropriate enhanced dispersion parameters are selected.

22643 (DOE/ER/60493—1-Vol.3, pp 198-202) **Proposed method of indoor air pollution control by dilution with outside air.** Guttmann, K. (Guttman & MacRitchie, San Francisco, CA). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Gaseous pollutants generated within the air conditioned space can be controlled by dilution. This is recognized in ASHRAE Standard 62-1981R, but no practical methodology is presented to compute the required percentage of outside air. This paper proposes such a method.

22644 (DOE/ER/60493—1-Vol.3, pp 221-225) **Control of residential formaldehyde levels by source treatment.** Godish, T.; Rouch, J. (Ball State Univ., Muncie, IN). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The efficacy of surface coatings applied to particleboard subflooring on formaldehyde levels was evaluated under temperature and humidity-controlled whole-house conditions. The most effective coating was Valspar formaldehyde sealant (70-83% reduction of formaldehyde). Hyde-Chek formaldehyde sealant gave more variable results (63-95% reduction). Tri-Con AP-10 formaldehyde barrier was shown to be ineffective in reducing formaldehyde when applied as a single coat but had an effectiveness of 67% when applied as two coats. Polyurethane varnish was only moderately effective in reducing formaldehyde levels (30-47%). Nitrocellulose and alkyd-resin were observed to be more effective than polyurethane. Surface coatings appeared to provide long-term reductions in formaldehyde levels.

22645 (DOE/ER/60493—1-Vol.3, pp 231-235) **Artificial electrostatic fields as air cleaning systems in rooms.** Sandberg, M.; Mellin, A. (National Swedish Institute for Building Research, Gaevle). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Laboratory tests were carried out in a small (vol. 3.8 m^3) plexiglas model of a room. The whole ceiling area was covered by a high voltage grid. Mineral dust and tobacco smoke were released in the room. The particle mass concentration of the mineral was determined by gravimetric analysis, while the concentration of the tobacco smoke was recorded with a photometer. In some of the tests an ion generator producing negative ions was in operation. Tests both with and without air ventilation were carried out. The findings show that at our test conditions the system reduces the particle concentration in the air. However, the practical application of these systems in occupied rooms raises many further questions.

22646 (DOE/ER/60493—1-Vol.3, pp 236-240) **Indoor air quality control capabilities of desiccant materials.** Relwani, S.M.; Moschandreas, D.J.; Billick, I.H. (IIT Research Institute, Chicago, IL). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

This paper reports the potential of using desiccants for reducing indoor concentrations of NO_2, CO, SO_2, and total hydrocarbons (THC). Two types of desiccants were studied. Experiments were performed using a bench scale apparatus and also a commercially available rotary desiccant unit. Three parameters were evaluated to study the control capabilities of desiccants to reduce indoor pollutant concentrations: (1) impact of air constituent's concentration level; (2) desiccant material; and (3) thermal regeneration capabilities of desiccants. It is concluded that desiccants can be used as a component of indoor pollution control systems.

22647 (DOE/ER/60493—1-Vol.3, pp 241-243) **New filter system for indoor pollution separation (particles, organic and inorganic gases).** Kettrup, A.; Klusmeier, W.; Ohrbach, K.H. (Univ. of Paderborn, Germany, F.R.). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The application of a new developed Iono-Carbosorb filter system for indoor pollution, esp. separation of particles, organic and inorganic gases is described in this paper. For this purpose we have investigated the adsorption of some selected compounds which are known as injurious for health like: methyl cyanide, 2-propenal, benzene, chloro-2,3 -epoxypropane, dichloromethane, pyridine, tetrachloromethane. The values of the adsorption capacities have been determined showing significant differences in depending on the chemical structure of the compound as well as the changes of the ionization installed in the Iono-Carbosorb filter.

22648 (DOE/ER/60493—1-Vol.3, pp 244-248) **Mass-transfer aspects of pollutant removal at indoor surfaces.** Nazaroff, W.W.; Cass, G.R. (California Institute of Technology, Pasadena). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The loss rate of particles and highly reactive gases to indoor surfaces depends on the diffusivity of the species and on the nature of the air circulation pattern within a room. Analysis of three airflow conditions that may be found adjacent to the walls of an enclosure-homogeneous turbulence, laminar forced convection, and laminar natural convection-reveals that the average pollutant deposition velocity may vary from order 10^{-4} to 1 cm/s over the range of pollutant diffusivities and particle sizes encountered. Theoretical predictions are in rough agreement with the limited experimental data that have been taken inside actual rooms.

22649 (DOE/ER/60493—1-Vol.3, pp 249-252) **Evaluation of proprietary detector as an indoor air quality sensor.** Klein, C.F.; Relwani, S.M.; Moschandreas, D.J. (Johnson Controls, Inc., Milwaukee, WI). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

In this paper we discuss a proprietary detector that may be used as an indoor air quality sensor in conjunction with a centralized and/or localized air contaminant removal device. Experiments are performed by exposing this detector to several indoor air constituents at various concentration levels. Air constituents include SO_2, NO_2, tetrachloroethane, tetrachloroethylene, xylene, dichlorobenzene, and trichloroethane. The performance characteristics used to evaluate this detector were sensitivity and selectivity. The results of the generated data base indicate that several of the indoor constituents are detected by the sensor and that the associated electronic system is able to provide real time analog output.

22650 (DOE/ER/60493—1-Vol.3, pp 255-260) **Relation between work parameters and construction of an exhaust ventilation system and burdensome of emission from industrial sources.** Bagienski, Z. (Technical Univ., Poznan, Poland). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Gaseous pollutants emitted from a factory building are removed through a suction as well as with mechanical and natural exhaust ventilation system. In the paper a relation between the effectiveness of a ventilation system and the dispersion of effluent pollutants from the stack was analyzed. The factors affecting the extent of dispersion were determined, as well. The value of dispersion effectiveness, influences onerousness of an object for a near environment of an emission source it is shown that it may effect a concentration of gaseous pollutants in supply air, as well.

22651 (DOE/ER/60493—1-Vol.3, pp 261-266) **Low cost control technology for VOC's emissions.** Chiang, P.C.; Chang, P. (National Taiwan Univ.). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

In this investigation it was found that the spent grain obtained from the brewery industry plant could be reclaimed as an adsorbent for removing volatile organic compounds (VOC/sub s/) through use of a pyrolysis technique. The adsorption capacity of VOCs on the reclaimed adsorbent was approximately equivalent to that of the coconut shell activated carbon. The results of adsorption isotherm tests were checked with the findings of Brounauer, Emmett and Teller (BET) surface area, CCl_4 activity, and elemental analysis. Further studies were shown in the column adsorption tests which indicated the column utilization ratio was approximately 86% when the 930 pm of methylethylketone was introduced to the column. During the desorption cycle, the percentage of solvent (MEK) recovery was observed to be 94% while a steam was operated at 190°C with a flow rate at 120 ml/min and steam consumption rate at 9 lb steam per lb of recovered solvent.

22652 (DOE/ER/60493—1-Vol.3, pp 267-272) **Test criteria for air cleaners.** Hangartner, M.; Wanner, H.U. (Federal Institute of Technology, Zurich, Switzerland). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Several types of air cleaners equipped with different filters and washers were tested according to their reducing power of indoor air pollutants. The tests were carried out in a climatic chamber of 30 m^3 and in an ordinary office room under field conditions. Two situations were simulated: effect on peak concentrations and on a constant source. The following pollutants were chosen: nitro-

gen dioxide, sulfur dioxide, formaldehyde and particles from tobacco smoke and odors of various kind. The odor abatement efficiency was evaluated by sensory methods. The amount of pollutants was reduced by 30 to 70% depending on the quality of the filters and the air volume.

22653 (DOE/ER/60493—1-Vol.3, pp 272-276) **Indoor measurements of nitrogen dioxide and sulfur dioxide in mechanically and naturally ventilated rooms compared with outdoor measurements.** Monn, C.; Hangartner, M.; Wanner, H.U. (Federal Institute of Technology, Zurich, Switzerland). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Weekly measurements were made to compare the indoor levels of NO_2 and SO_2 with outdoor levels in different rooms in a city and in the countryside. Measurements were effected with passive sampling diffusion tubes. The following NO_2 indoor/outdoor ratios were found: 0.6 - 0.7 in air-conditioned rooms (winter), 0.2 - 0.4 in air-conditioned rooms with special air filters, 0.25 - 0.45 in dwellings with natural ventilation (winter) and about 1.0 in summer. The indoor concentration of pollutants depends on the outdoor concentration of pollutants, the type of ventilation and filtration and the air exchange rate.

22654 (DOE/ER/60493—1-Vol.3, pp 277-282) **Ventilation requirements in building for control of body odor.** Narasaki, M. (Osaka Univ., Japan). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The author investigate the relationship between the indoor CO_2 level caused by sedentary occupants' expiration and subjective evaluation of body odor by visitors by means of the same method as Yaglou's, and try to estimate the ventilation criteria for sedentary persons. Subjective evaluations of body odor are carried out in an environmental chamber as model tests and in classrooms as field tests. The experiments was carried out with various combinations of temperature, humidity, occupancy density and occupants sweating condition. From the results, we may conclude that the CO_2 level is a potential index of body odor and 80% of visitors may be satisfied with indoor air quality, if CO_2 level be kept less than 0.1% which is adopted as Japanese ventilation standards.

22655 (DOE/ER/60493—1-Vol.3, pp 288-293) **Advisory model formaldehyde.** Panzhauser, E.; Heindl, W.; Fail, A. (Technical Univ., Vienna, Austria). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

After a flood of complaints of inhabitants in Austrian residences and in order to offer proper remedial measures against HCHO indoor pollution an Advisor Model Formaldehyde was developed, which evaluates the effects of strength or change of formaldehyde emissivity of cooking cycles, furniture, cladding; air change regulation (infiltration/exfiltration, window airing, forced ventilation); and influence of temperature and humidity on the momentary and continuous concentration of HCHO in the indoor air.

22656 (DOE/ER/60493—1-Vol.3, pp 357-361) **Sick buildings - a ventilation problem.** Hanssen, S.O.; Mathisen, H.M. (Norwegian Institute of Technology, Trondheim). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

A comparative investigation based on climate-technical measurements combined with a questionnaire has been carried out at two schools in Trondheim. At school A there is a normal degree of absenteeism; school B, however, shows an abnormal degree of absenteeism among the staff. As to construction and design the two schools are alike, but there is a big difference in ventilation air flow rates. Low air exchange rate combined with new building materials is probably the main cause of dissatisfaction at school B.

22657 (DOE/ER/60493—1-Vol.3, pp 362-366) **Performance of turbulent airflow clean rooms - based on airborne particle counts in a model room.** Kubo, T.; Fujii, S.; Hayakawa, I. (Kanazawa Institute of Technology, Japan). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Using the model room for turbulent airflow clean room, we experimentally analyzed the performance of such clean rooms. Through the analyses on the change of airborne particle counts along time, we, in this paper, proposed the Potential Number of Air Change as the indicator of effective ventilation power of clean zone. Using this indicator, some relationship between operating conditions and the performance of clean rooms were made clear.

22658 (DOE/ER/60493—1-Vol.3, pp 515-520) **Role of total exposure in air pollution control strategies.** Girman, J.; Wesolowski, J.; Jenkins, P. (California Dept. of Health Services, Berkeley). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

This paper discusses the need for total exposure considerations to be incorporated into existing air quality programs, to assure the most effective protection of public health. New information, i.e., high indoor concentrations of some air pollutants and longer exposure times indoors, has demonstrated the importance of taking into account all important microenvironments when assessing risk and determining the best control strategies. Best control strategies are developed for several pollutants through application of three criteria: reduction of public health risk; relative effectiveness of the control strategies; and social and political feasibility. Examples presented illustrate the need for, and the feasibility of, integration of indoor and outdoor air quality strategies.

22659 (DOE/ER/60493—1-Vol.3, pp 548-549) **Presentation and evaluation of a step-wise procedure in solving indoor climate problems.** Hansen, L. (Univ. of Copenhagen, Denmark). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Based on the study in a single county the Danish Labor Inspection Service now has adopted a strategy in solving indoor climate problems. The study showed that half of the problems in institutions could be solved without use of technical sophisticated measurements.

22660 (DOE/ER/60493—1-Vol.3, pp 558-561) **Spray applied asbestos and comparable products.** Bossenmayer, H. (Innenministerium Baden, Wuerttemberg, Germany, F.R.). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Because of the small amount of binding material spray applied asbestos and comparable products by the time lose their cohesion as well as their adhesion to building elements to which they are fixed. In any case, only depending on the time, abatement measures will become necessary. Three types of measures apply: (a) removal, (b) strengthening and air-tight encapsulation by airless sprayed synthetic products, and (c) air tight separation. The urgency of abatement measures needs to be deduced from criteria which describe the state and situation of the product, possibility and type of injuries, age and number of users and may then be given higher or lower priority. Work may be considered to be successful if after finalization of abatement measures, followed by dry and wet clean-

ing, the air-borne fiber concentration is measured lower than 500 f/m^3.

22661 (DOE/ER/60493—1-Vol.3, pp 567-572) **American Industrial Hygiene Association indoor environmental quality reference manual.** Gammage, R.B.; Kerbel, W.S. (Oak Ridge National Lab., TN). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3). Contract AC05-84OR21400.

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The American Industrial Hygiene Association (AIHA) Committee on Indoor Air Quality has prepared a manual dealing with asbestos, carbon monoxide, formaldehyde, microorganisms, nitrogen oxides, odors, pesticides, respirable particulates, ventilation, and volatile organic compounds. The introductory chapter presents a generic scheme for determining the cause of health complaints and includes an example of a health questionnaire. Each following chapter is designed primarily to assist persons investigating health complaints in non-industrial working environments with selecting appropriate sampling and analytical techniques and applying them to the problems at hand. A characterization is made of each of the pollutant categories and the hazards they pose. Consideration is also given to nonindustrial standards, and guidelines, and to action levels for making more detailed measurements. The manual will be published and sold by AIHA.

22662 (DOE/ER/60493—1-Vol.3, pp 579-583) **Regulating formaldehyde in Minnesota.** Oatman, L. (Minnesota Dept. of Health, Minneapolis). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

During the late 1970's, Minnesota initiated an investigation of the presence of formaldehyde in residential buildings. Between 1979 and 1981, the Health Department sampled over 950 conventional and manufactured homes for formaldehyde gas; the levels of formaldehyde ranged from less than 0.02 parts per million (ppm) to 5.51 ppm. As a result of public concern, the Minnesota Legislature enacted a formaldehyde-containing materials and housing units, and mandated that the Health Department adopt standards for the sale of products containing urea formaldehyde. An indoor air standard of 0.4 ppm for new homes was adopted by the Health Department; the air standard was later replaced by product standards. The use of an air standard was not a reasonable approach to solving formaldehyde problems in Minnesota's homes.

22663 (DOE/ER/60493—1-Vol.3, pp 594-597) **Questionnaire, a possibility of treating indoor problems.** Zingg, M. (Environmental Toxicology, Schaffhausen, Switzerland). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The questionnaires are based on a multi-stage principle. The first step serves to restrict the cause as far as possible. In the second step, the most specific facts possible are collected. In the first step, the following ranges are covered: kind of the housing space and location, pieces of furniture, symptoms and way of living. Only fundamental facts are collected. In the second step the specific collection of facts takes place. It is necessary to record all events chronologically to recognize the correlation. Based on the second step it is possible in most of the cases to propose sanitation. Is that impossible or can only symptoms be observed, a third step is necessary to make special investigations in the room. Depending on the financial state, the sanitation can follow gradually according to priorities without leading to a great ascertainment of facts again.

22664 (DOE/ER/60493—1-Vol.4, pp 9-16) **Allergens in the indoor environment.** Jorde, W.; Schata, M. (Asthmakrankenhaus der Kamillianer, Moenchengladbach, Germany, F.R.). 1987. NTIS, PC A 07. Order Number DE88004516/JAW. (CONF-870853—Vol.4).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The most frequent indoor allergens (pollen, animal dander, mites, molds and occupational allergens) are reported. The possibilities of removing these allergens from indoors or of avoiding them are described. Special attention is paid to mold allergens as problematical substances in our interior rooms, above all at air-conditioned places of work, as well as in transport facilities with automatic ventilation (airplanes, railway compartments, buses and motorcars).

22665 (DOE/ER/60493—1-Vol.4, pp 49-56) **Solution to the sick building mystery.** Fanger, P.O. (Technical Univ. of Denmark, Lungby). 1987. NTIS, PC A 07. Order Number DE88004516/JAW. (CONF-870853—Vol.4).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Severe complaints of stale, stuffy and unacceptable indoor air have been reported in buildings throughout the world. In many cases it has been impossible to identify a measurable cause. This paper offers a solution to this mystery. A new unit, the olf, is introduced to quantify pollution sources. A field study in twenty commercial buildings identified substantial pollution sources in materials in the spaces and in the ventilation systems. The quantified pollution sources explain why a sick building syndrome might exist. They explain why apparent high ventilation rates may be insufficient to provide acceptable air quality. They explain why CO_2 often fails to predict acceptable indoor air. They explain why natural ventilation in some cases may provide better air quality than mechanical ventilation. Systematic ways of quantifying and decimating pollution sources in existing and future buildings are recommended.

22666 (DOE/ER/60493—1-Vol.4, pp 69-78) **Airborne bacteria and the indoor climate.** Dennis, P.J.L. (Public Health Lab. Service, Wiltshire, England). 1987. NTIS, PC A 07. Order Number DE88004516/JAW. (CONF-870853—Vol.4).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Since the 1940's there has been an increase in the awareness and appreciation of the importance of airborne infection. The importance of particle size (< 5 μm) and the concept of droplet nuclei which remain suspended in air for considerable periods have been seen as important determinants of infectivity. The appearance of humidifier fever caused by thermophilic actinomycetes and amoebae and the recognition of Legionnaires' disease has lead to an appreciation of the microbiological dangers posed to individuals in modern buildings. These microorganisms like the legionellaceae are aquatic in nature and are able to colonize building water services probably gaining access via the public water supply. Proliferation of these organisms within building water systems, humidifiers and air conditioning equipment is associated with inadequate maintenance or infrequent usage. These factors provide the ideal conditions for settlement and growth of organisms in water handling equipment. The survival of these organisms or their toxins in aerosols produced by water handling equipment can lead to the establishment of disease in susceptible individuals who inhale them.

22667 (DOE/ER/60493—1-Vol.4, pp 91-104) **Indoor air pollution controls.** Moschandreas, D.J. (IIT Research Institute, Chicago, IL). 1987. NTIS, PC A 07. Order Number DE88004516/JAW. (CONF-870853—Vol.4).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Removal of indoor pollution generating sources prevents indoor air pollution. Modification of indoor sources, increase of the ventilation rates, pollution control devices, and other removal mechanisms mitigate indoor air pollution. This review addresses prevention and abatement mechanisms for pollutants or pollutant groups. Pollutants addressed individually are formaldehyde and radon, pollutant groups include particulate matter, products of

combustion, and volatile organic compounds. Present level of knowledge is discussed for each topic, the effectiveness of each control mechanism is addressed, and non pollution effects such as potential conflicts with energy conservation measures, financial and other stresses are also considered. Finally, knowledge gaps are pointed out and research directions are suggested.

22668 (DOE/ER/60493—1-Vol.4, pp 105-116) **Public policy implications of exposure of indoor pollution.** Sexton, K. (Environmental Protection Agency, Washington, DC). 1987. NTIS, PC A 07. Order Number DE88004516/JAW. (CONF-870853—Vol.4).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The importance of air pollution concentrations in nonindustrial indoor environments for accurate exposure characterization is now recognized. To date, research efforts have focused on the relevant scientific and technical questions. Consequently, relatively little attention has been paid to identifying and resolving the key policy questions. This paper examines the implications of indoor air pollution for risk assessment and risk management.

22669 (DOE/ER/60493—1-Vol.4, pp 117-134) **Assessing the relative risk of indoor exposures and hazards, and future needs.** Lindvall, T. (National Institute of Environmental Medicine, Stockholm, Sweden). 1987. NTIS, PC A 07. Order Number DE88004516/JAW. (CONF-870853—Vol.4).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Some important pollutants indoors (radon, mold growth, nitrogen dioxide, formaldehyde and irritants behind the sick building syndrome) are commented from the view point of risk assessment. Temporal and population aspects of indoor exposure are discussed. Risk management is viewed from an historical and perceptual angle, and future needs are indicated. On overall view of action is supported, including a screening of chemicals, a specific control of selected compounds, an evaluation of design and system solutions, an evaluation of occupant/environment interactions, and the establishment of air quality guidelines incorporating adequate safety margins.

22670 (EPRI-EA—5571, pp C.3-C.8) **Development and evaluation of the EPRI hybrid plume model.** Hanna, S.R.; Weil, J.C.; Paine, R.T. (Sigma Research Corp., Lexington, MA). Dec 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920141/JAW. (CONF-8602157—).

From EPRI air quality modeling contractors meeting; Palo Alto, CA, USA (25 Feb 1986).

The objective of the EPRI Hybrid Plume Model Development and Evaluation project is to produce a model for the dispersion of tall stack plumes that accounts for current knowledge of boundary layers turbulence and diffusion and can easily be applied to predict ground level concentrations over a basic averaging time of one hour for thousands of hours of emissions and meteorological data. The model is evaluated using the EPRI Kincaid and Bull Run data sets. This summary report briefly reviews the recent accomplishments of this project.

22671 (EPRI-EA—5571, pp C.11-C.20) **Progress in LES modeling of transport and dispersion.** Chen, C.; Hadfield, M.; Rutan, D.; Cotton, W.; Pielke, R. (Colorado State Univ., Fort Collins). Dec 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920141/JAW. (CONF-8602157—).

From EPRI air quality modeling contractors meeting; Palo Alto, CA, USA (25 Feb 1986).

The Colorado State University (CSU) Regional Atmospheric Modeling System (RAMS) is applied to the atmospheric boundary layer (ABL) research. In order to minimize the closure problem, the authors use the technique called Large-Eddy-Simulation (LES) to explicitly simulate the boundary layer large eddies. The small eddies, which have sizes within the inertial subrange, are then parameterized. Although CSU RAMS has been successfully applied to the simulation of various weather systems, including towering cumuli, mature tropical and mid-latitude cumulonimbi, mountain slope and valley circulations, orographic clouds and one-dimensional marine stratocumulus clouds, it is the first time it is applied to boundary layer LES studies. The aim of this study is to demonstrate the accuracy and versatility of the modeling approach and extend the approach to more complex problems such as hilly terrain and buoyant plume dispersion. 15 references.

22672 (EPRI-EA—5571, pp C.23-C.28) **Development of a hierarchy of improved plume models.** Lewellen, W.S.; Sykes, R.I.; Parker, S.F. (Aeronautical Research Associates of Princeton, Inc., NJ). Dec 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920141/JAW. (CONF-8602157—).

From EPRI air quality modeling contractors meeting; Palo Alto, CA, USA (25 Feb 1986).

This project is aimed at developing, evaluating, and documenting a hierarchy of improved plume models appropriate for tracking emissions from fossil-fueled power plants. The technical approach involves both the development of a high resolution, three-dimensional, time-dependent, dynamical model of the plume as well as a low-resolution, relatively simple Gaussian plume model which is an integral version of the complete model. At all levels of approximation the second-order closure description of turbulent transport is being used to provide a natural framework for considering both the diffusing effect of wind fluctuations and the contribution of wind fluctuations to an inherent uncertainty in the time-averaged concentration values. The authors are now at the critical stage of developmental testing and refining the model at three levels of approximation. 12 references.

22673 (EPRI-EA—5571, pp C.31-C.35) **Development of a nested grid mesoscale model with four-dimensional data assimilation.** Seaman, N.L.; Warner, T.T.; Chang, H.R.; Stauffer, D.R. (Pennsylvania State Univ., University Park). Dec 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920141/JAW. (CONF-8602157—).

From EPRI air quality modeling contractors meeting; Palo Alto, CA, USA (25 Feb 1986).

This project is designed to develop, evaluate, and document an improved version of the Penn State/NCAR three-dimensional mesoscale model (MM) suitable for use in air quality problems on the mesobeta scale (10-100 km). To allow more accurate simulation of emission transport on this scale, the primitive equation dynamic model has been upgraded to allow balanced initialization of realistic three-dimensional variable fields, integration on two-way interactive nested grids, assimilation of observed data in space and time throughout the integration, and improved representation of planetary boundary layer (PBL) physical processes. Simulated fields of wind, temperature, and moisture can be used alone or in conjunction with smaller-scale models of turbulent transport to better understand plume concentration and movement. All the necessary model components have been developed, and the authors are currently testing and evaluating the finished model on a number of cases with moderate terrain before moving on to an independent validation data set. 6 references.

22674 (EPRI-EA—5571, pp C.38-C.43) **Nitrogen oxide transformations in power plant plumes.** Sverdrup, G.M.; Spicer, C.W. Dec 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920141/JAW. (CONF-8602157—).

From EPRI air quality modeling contractors meeting; Palo Alto, CA, USA (25 Feb 1986).

Stack emissions from fossil-fueled power plants are a major source of oxides of nitrogen. The most important oxides of nitrogen in terms of concentration are nitric oxide emitted from power plants, nitrogen dioxide formed in the atmosphere from NO, and nitric acid and peroxyacetyl nitrate (PAN), both formed from NO_2. The rate at which nitrogenous compounds are removed from the atmosphere by wet and dry deposition depends upon their chemical identity. Hence, in order to link the emission of NO to subsequent downwind deposition of NO_2, HNO_3, PAN, and other nitrogenous species, it is vital to know (1) the rate at which nitrogen oxides

(NO/sub x/ = NO + NO_2) are transformed to reaction products, and (2) the influence of environmental factors on these NO/sub x/ transformations. Accurate linkage of NO emissions to downwind deposition of nitrogenous compounds is vital if emissions control strategies are contemplated in order to reduce downwind deposition. The objectives of this project are to gain an improved understanding of nitrogen oxide chemistry in power plant plumes, and to provide a kinetic mechanism for simulation of chemical transformations of nitrogen oxides emitted from fossil-fueled power plants. Results are summarized.

22675 (EPRI-EA—5571, pp C.47-C.57) **Feasibility study of receptor modeling for apportioning utility contributions to air constituents, deposition quality, and light extinction.** Javitz, H.S.; Watson, J.G. Dec 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920141/JAW. (CONF-8602157—).

From EPRI air quality modeling contractors meeting; Palo Alto, CA, USA (25 Feb 1986).

The objective of this research effort is to determine the feasibility of using receptor models for the apportionment of utility contributions to air quality, deposition quality, and light extinction on local and regional scales. Those aspects of receptor modeling that prove to be promising but require more investigation are to be identified as topics suitable for EPRI funded research. Sixteen key criteria for evaluating the feasibility and usefulness of receptor models were identified, and are discussed. The conclusions reached for these 16 feasibility criteria indicate that receptor modeling can be applied to identify utility emissions subject to the results of recommended developmental work.

22676 (EPRI-EA—5571, pp C.61-C.68) **Simulation of the polluted coastal urban boundary layer.** Bornstein, R.; Klotz, S.; Salvador, R.; Pechinger, U.; Ludwig, F.; Shieh, L.J.; Street, R. (San Jose State Univ., CA). Dec 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920141/JAW. (CONF-8602157—).

From EPRI air quality modeling contractors meeting; Palo Alto, CA, USA (25 Feb 1986).

Since 1981, the authors have been working to develop a linked set of planetary boundary layer (PBL) and air pollutant dispersion models. The resulting models have been used to simulate sulfur dioxide concentrations in the coastal urban environment of New York City during sea breeze flow conditions. The PBL model simulates time-varying three-dimensional distributions of velocity, temperature, and (subsaturation) moisture in the PBL. The model consists of three layers: a constant-flux surface boundary layer (SBL), in which mean field variables are one-dimensional and analytic, an upper transition layer in which the hydrodynamic and thermodynamic equations describing atmospheric transport are solved numerically by finite-differences, and a subsurface soil layer in which soil temperature and moisture are obtained from finite difference solutions to the soil heat and moisture diffusion equations, respectively. A three-dimensional Eulerian grid air pollution dispersion model has also been developed. The dispersion model solves the mass conservation equation for the change of sulfur dioxide concentration with time, while the PBL model provides the nondivergent wind fields and the vertical component of the eddy diffusivity fields. The present model assumes a uniform horizontal diffusivity, as well as a constant linear chemical reaction rate. Results from the initial simulations showed the dispersion model capable of correctly reproducing most of the qualitative features of the observed sulfur dioxide concentration fields over NYC. The model is generally somewhat less successful in reproducing the exact values of the observed concentrations; however, most predicted concentration values were within a factor of two of corresponding observed values. 20 references, 5 figures.

22677 (EPRI-EA—5571, pp C.71-C.78) **Influence of terrain-forced mesoscale systems in long-range transport of airborne gases and aerosols.** Pielke, R.A.; Segal, M.; Arritt, R.W.; Moran, M.D. (Colorado State Univ., Fort Collins). Dec 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920141/JAW. (CONF-8602157—).

From EPRI air quality modeling contractors meeting; Palo Alto, CA, USA (25 Feb 1986).

When higher time resolution radiosonde information is not available, it has been proposed to utilize numerical meteorological models on the regional scale to predict the evolution of atmospheric features between the standard twice-a-day synoptic observation times. The NCAR/Penn State model will be run with a horizontal grid mesh of either 80 km or 160 km for most of the case studies, although selected integrations with a 27-km grid will be applied using a nested model approach. Assuming that at least four grid increments are needed to adequately resolve an atmospheric feature, only wavelengths larger than 108 km will be realistically represented in NCAR's finest resolution trajectory experiments. Smaller-scale atmospheric features, unfortunately, will be missed and it is these systems, specifically terrain-forced mesoscale circulations, which the authors propose to investigate. The modeling tools which they are using in this study are a three-dimensional, hydrostatic mesoscale model version of the Colorado State University Regional Atmospheric Modeling System (RAMS) and a Lagrangian particle dispersion model which uses the meteorological output from the RAMS model. Progress to date is discussed. 10 references.

22678 (EPRI-EA—5571, pp C.80-C.99) **Development of the acid deposition and oxidant model (ADOM).** Venkatram, A.; Lurmann, F. Dec 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920141/JAW. (CONF-8602157—).

From EPRI air quality modeling contractors meeting; Palo Alto, CA, USA (25 Feb 1986).

The ERT model development program is in the second phase of a two-phase project. Phase I consisted of the design of a long-range transport model that met the following criteria: (1) the model should stand up to critical scrutiny by the scientific community; and (2) it should be flexible enough to allow the incorporation of the rapidly evolving knowledge of the processes governing the transport and deposition of acidifying pollutants. This design was then the basis for Phase II which is currently in progress. The first component of Phase II is the development of modules that represent the major atmospheric processes that contribute to acid deposition. During the next three years, ERT will focus on two major activities: (1) development of an improved cloud/scavenging module; (2) intercomparison and evaluation of the modules/model. This paper reviews the progress to date on these two objectives.

22679 (GSF—10/87, pp 66-75) **Deposition of pollutants in forest ecosystems as a function of meteorological parameters.** Georgii, H.W.; Grosch, S.; Schmitt, G. (Frankfurt Univ., Germany, F.R. Inst. fuer Meteorologie und Geophysik). Mar 1987. (In German). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88752006/JAW. (CONF-8610391—).

From Symposium on climate and weather as related to the novel forest disease; Neuherberg, F.R. Germany (13 Oct 1986).

Wet deposition is the product of precipitation rate and trace material concentration in rainwater. This acquires particular importance regarding orographic precipitations in mountain slopes. Measurements of wet and dry deposition were carried through from 1979 to 1981 in a measuring grid covering the whole of the Federal German territory. The results of the deposition measurements, measurements in stands, and measurements of interception from fog water are presented.

22680 (N—88-13774, pp vp) **Use of TOMS data for tropospheric ozone studies.** Fishman, J.; Browell, E.V. Dec 1987. NTIS, PC A06/MF A01. (NASA-CP—2497; REPT—87B0206; NAS—1.55:2497; CONF-8609399—).

From Scientific and operational requirements for TOMS data; Greenbelt, MD, USA (10 Sep 1986).

Instances were identified where enhancements of tropical ozone are associated with sporadic widespread biomass burning. A strong positive correlation exists between total ozone and the distribution of carbon monoxide in the tropics, indicating that total ozone data can be used for tropospheric ozone studies. Using ozone profiles derived from the Stratospheric Aerosol and Gas Experiment (SAGE), preliminary findings show enhanced tropospheric ozone concentrations over Africa and the eastern Atlantic at tropical latitudes. Other preliminary studies also suggest that Total Ozone Mapping Spectrometer (TOMS) data may provide a means

of identifying widespread air pollution episodes over the United States during the summer.

22681 **(PB—88-127741/XAB) Combined aerodynamic size, charge-to-mass and velocity measurements of aerosol particles.** Hunik, R. (Keuring van Electrotechnische Materialen N.V., Arnhem (Netherlands)). 1987. 14p. NTIS, PC E03/MF A01.

Pub. in Kema Scientific and Technical Reports, Vol. 5, No. 4, 73-81(1987).

A method is described for the determination of the aerodynamic size, charge-to-mass ratio and velocity of aerosol particles. The method involves the application of acoustic and/or alternating electric fields over the measuring volume of a laser doppler anemometer (LDA). The induced oscillating motion of an aerosol particle passing this measuring volume causes a frequency-modulated LDA signal. The characteristics of the oscillations and hence the aerodynamic size and charge-to-mass, as well as the velocity of the aerosol particle, can be determined after Fourier transformation of these signals. Experimental results regarding monodisperse particles show that not only histograms of aerodynamic sizes, charges and velocities but also e.g., turbulences and charges as a function of aerodynamic sizes can easily be determined with this method.

22682 **(PB—88-129481/XAB) Development of the National Acid Precipitation Assessment Program (NAPAP) Emissions Inventory, 1980: the Flexible Regional Emissions Data System (software, allocation factor files, peripheral data files). Software.** Mobley, J.D.; Lebowitz, L.G. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). 1987. mag tap. (EPA—600/7-87/025B). NTIS CP T08.

Source tape is in the EBCDIC character set. This restricts preparation to 9 track, one-half inch tape only. Identify recording mode by specifying density only. Call NTIS Computer Products if you have questions. Price includes documentation, PB—88-129499.

This package contains documentation of the Flexible Regional Emissions Data System (FREDS) for the 1980 NAPAP Emissions Inventory, FREDS source code, allocation factor files, and peripheral data files. FREDS extracts emissions data, pertinent modeling parameters (e.g., stack height, exhaust-gas temperature, etc.) and source-identification information from Emissions Inventory System (EIS) Master File records or preprocessed Statistical Analysis System (SAS) files and applies appropriate temporal, spatial, and pollutant-species allocation factors to derive a gridded, speciated, and temporally resolved emissions file suitable as input to regional scale atmospheric simulation models (such as the Regional Acid Deposition and Regional Oxidant Models). FREDS consists of five main modules which are used to apply allocation-factors to the annual emissions data, plus peripheral software used to ensure the quality of and maintain the allocation factor files. Separate programs are used to process point and area sources. Each module requires a user-defined control-options file. The five primary modules are the Model Data Extraction Module (MDEM), the Temporal Allocation Module (TAM), the Speciation Module (SM), the Spatial Allocation Module (SAM), and the Model Input Preprocessor (MIP). To maximize flexibility, FREDS allows the user to define and assign emissions of up to 15 pollutants (referenced by SAROAD code), the temporal scenario, spatial grid origin and grid cell size, and the number and relationship of pollutant subspecies. FREDS' modules are written in the language of the Statistical Analysis System...Software Description: The model is written in the SAS programming language for implementation on a IBM 3090 Computer using the OS/TSO operating system. Memory requirement is 1536 K bytes.

22683 **(PB—88-129499/XAB) Flexible Regional Emissions Data System (FREDS) documentation for the 1980 NAPAP (National Acid Precipitation Assessment Program) emissions inventory. Final report.** Lebowitz, L.G.; Ackerman, A.S. (Alliance Technologies Corp., Bedford, MA (USA)). Nov 1987. 441p. (EPA—600/7-87/025A). NTIS, PC A19/MF A01.

For system on magnetic tape, see PB—88-129481.

This report documents the development of the Flexible Regional Emissions Data System (FREDS) for the 1980 NAPAP Emissions Inventory. FREDS extracts emissions data, pertinent modeling parameters (e.g., stack height, exhaust gas temperature), and source identification information and applies appropriate temporal, spatial, and pollutant species allocation factors to derive a gridded, speciated, and temporally resolved emissions file suitable as input to regional-scale atmospheric simulation models (e.g., Regional Acid Deposition Model, Regional Oxidant Model). FREDS consists of five main modules (i.e., Model Data Extraction Module, Temporal Allocation Module, Speciation Module, Spatial Allocation Module, and Model Input Preprocessor) which are used to apply allocation factors to the annual emissions data, plus peripheral software used to ensure the quality of (and maintain) the allocation factor files.

22684 **(PB—88-132121/XAB) Development of the 1980 NAPAP (National Acid Precipitation Assessment Program) Emissions Inventory. Final report, January 1985-October 1986.** Wagner, J.K.; Walters, R.A.; Maiocco, L.J.; Neal, D.R. (Alliance Technologies Corp., Bedford, MA (USA)). Dec 1986. 453p. (GCA-TR—86-12-G). NTIS, PC A20/MF A01.

For system on magnetic tape, see PB—88-137138 through PB—88-137427.

This report documents the development of the 1980 National Acid Precipitation Assessment Program (NAPAP) Emissions Inventory. The current version of the annual inventory, Version 5.0, and the related Version 5.2 Eulerian Modeling Inventory and Version 5.3 Regional Oxidant Modeling Inventory represent the most-comprehensive, highest-quality emissions data available for the 1980 base year. The inventory spans the 48 contiguous U.S. states and 10 Canadian provinces, providing detailed point-source data for over 14,000 plants and area source information by source category for 3070 U.S. counties. Canadian area source data are reported at the province level. Emissions from 11 pollutants (SO_2, SO_4, NOx, Pb, CO, HCl, HF, NH_3, TSP, VOC, and THC) are included in the 5.0 Inventory; in the 5.2 Modeling Inventory, pollutants are disaggregated into 39 classes. Version 5.0/5.2 emissions of SO_2, NOx, and VOC are 32.1, 24.4, and 26.2 million tons/yr, respectively. Summaries of emissions data are presented at various levels of aggregation including nation, EPA region, state/province, and source category. Emissions data are also analyzed by plant size, stack height, and general source type, and emissions variations are examined on seasonal and daily bases. The Version 5 Inventory represents the last of a series of NAPAP inventory efforts for base year 1980.

22685 **(PB—88-132519/XAB) National Atmospheric Deposition Program/National Trends Network (NADP/NTN) site visitation program: summary report for the period December 1984 through September 1986.** Eaton, W.C.; Tew, E.L.; Moore, C.E.; Ward, D.A. (Research Triangle Inst., Research Triangle Park, NC (USA)). Nov 1987. 153p. NTIS, PC A08/MF A01.

The proper collection of precipitation and the accurate measurement of its constituents are important steps in attaining a better understanding of the distribution and effects of acid rain in the United States. One of NAPAP Task Group IV's major programs concerns wet deposition monitoring. The document is a summary report of the findings from the 1985-1986 Site Visitation Program to the 195 sites that comprise the National Atmospheric Deposition Program and National Trends Network precipitation networks, referred to collectively as the NADP/NTN network.

22686 **(PB—88-132907/XAB) Methods for estimating on-site ambient air concentrations at disposal sites.** Hwang, S.T. (Environmental Protection Agency, Washington, DC (USA). Office of Health and Environmental Assessment). 23 Feb 1987. 7p. (EPA—600/J-87/109). NTIS, PC A02/MF A01.

Pub. in Nuclear and Chemical Waste Management, Vol. 7, 95-98(Jun 1987).

Currently, Gaussian-type dispersion modeling and point-source approximation are combined to estimate the ambient air concentrations of pollutants dispersed downwind of an area-wide emission source, using the approach of virtual-point-source approximation. The Gaussian-dispersion modeling becomes less accurate as the receptor comes closer to the source, and becomes inapplicable for the estimation of on-site ambient air concentrations at disposal

sites. Partial differential equations are solved with appropriate boundary conditions for use in estimating the on-site concentrations in the ambient air impacted by emissions from an area source such as land-disposal sites. Two variations of solution techniques are presented, and their predictions are compared.

22687 **(PB—88-133038/XAB) Formation and fate of toxic chemicals in California's atmosphere. Final report, July 10, 1984-November 22, 1985.** Pitts, J.N.; Atkinson, R.; Winer, A.M.; Arey, J.; Tuazon, E.C. (California Univ., Riverside (USA). Statewide Air Pollution Research Center). Nov 1985. 88p. NTIS, PC A05/MF A01.

See also report dated July 1984, PB—85-172609.

An experimental program was carried out utilizing environmental chambers with in-situ long-pathlength Fourier-transform infrared spectroscopy, a flash photolysis-resonance fluorescence apparatus and combined gas chromatography-mass spectrometry (GC/MS) to investigate the atmospheric chemistry of trimethylphosphate, nitrobenzene, chlorobenzene, aniline, N,N-dimethylaniline, pyridine, 1,3,5-triazine, and methylethyl-, dimethyl- and trimethylamine, a series of chemical compounds closely related to toxic air contaminants in present use by industry and in agricultural operations. In addition, 1,2-dibromo-3-chloropropane (DBCP), until last year a widely-used soil fumigant and nematicide, was studied. The kinetic data obtained allowed atmospheric lifetimes to be calculated for the reaction of these chemicals with hydroxyl (OH) radicals and with ozone, and for certain of the N-containing agents with gaseous nitric acid (HNO_3). In all cases, reaction with O_3 was a minor atmospheric loss process. The atmospheric lifetimes of the 12 compounds against reaction with OH radicals (their major loss process under clean or moderately polluted conditions) ranged from 1 hr in the case of N,N-dimethylaniline and aniline to approximately 150 days for 1,3,5-triazine. The influence of the calculated lifetimes on the geographical distribution and impacts of these chemicals is discussed.

22688 **(PB—88-133269/XAB) Methods-comparison measurements during the Carbonaceous-Species Methods Comparison Study, Glendora, California, August 1986: tunable-diode laser absorption spectrometer measurements of HCHO, H_2O_2 and HNO_3. Final report.** Mackay, G.I.; Schiff, H.I. (Unisearch Associates, Inc., Concord, Ontario (Canada)). 21 Oct 1987. 201p. NTIS, PC A10/MF A01.

As part of the Carbonaceous-Species Methods Comparison Study at Citrus College, Glendora CA, on August 11-21, 1986, Unisearch Associates participated in methods evaluation studies for formaldehyde (HCHO), hydrogen peroxide (H_2O_2) and nitric acid (HNO_3). These three species play important roles in photochemistry of urban and rural air, and their measurements provide sensitive tests for current acid deposition and urban smog models. Two tunable diode laser absorption spectrometers (TDLAS) were used in the methods evaluation study.

22689 **(PB—88-133434/XAB) Analysis of hydrogen peroxide in Los Angeles atmosphere. Hydrogen peroxide analyses during the Carbonaceous-Species Methods Comparison Study at Citrus College on August 11-21, 1986. Final report.** Kaplan, I.R.; Sakugawa, H. (California Univ., Los Angeles (USA). Inst. of Geophysics and Planetary Physics). 10 Nov 1987. 14p. NTIS, PC A03/MF A01.

See also PB—88-133442.

A novel method for the capture of hydrogen peroxide was used in the analyses of gas-phase peroxides in the Los Angeles atmosphere. The method employed the freezing of hydrogen peroxide and water vapor in air, passing through a glass trap cooled by dry ice. The method has the advantage of simplicity of operation, low cost of deployment and little or no artifact formation due to prevention of ozone reaction with organic constituents in the air or on glass surfaces. The range of values were from 0.07-0.90 ppb with maxima during 1200-1600 hrs and minima during 2000-2400 or 2400-0800 hrs. Only total peroxide content was determined in all the samples except two, due to the relatively low concentration of gaseous peroxide. In two samples, H_2O_2 was discriminated from organic peroxide by catalase. The results showed greater than 95% of total peroxide was H_2O_2 in both samples.

22690 **(PB—88-133442/XAB) Quality-assurance audits for the ARB (Air Resources Board)-sponsored Carbonaceous Species Methods Comparison Study at Citrus College, Glendora, California, August 12-21, 1986. Final report.** Countess, R.J. (Environmental Monitoring and Services, Inc., Camarillo, CA (USA)). 21 Sep 1987. 30p. (EMSI—51151QA.FR). NTIS, PC A03/MF A01.

See also PB—88-133434.

A series of quality-assurance tasks were performed in support of the Air Resources Board-sponsored Carbonaceous Species Methods Comparison Study, conducted at Citrus College in Glendora, CA, August 1986. The project summarizes the quality assurance efforts for the study, which included: (1) flow rate audits for all samplers deployed in the nine day field study; (2) preparation and supplies of carbonaceous reference materials for an interlaboratory round-robin study; and (3) analysis of the reference materials as well as 20% of the ambient particulate samples collected by each of the study participants for both organic and elemental carbon. The final task was done in order to assess the influence of samplers upon collected particulate carbon.

22691 **(PB—88-133582/XAB) Assessing potential effects of incinerating hazardous wastes at sea: development and field-testing of the marine biological assessment sampler.** Redford, D.; Jackson, M.; Oberacker, D.; Cooke, M.; Kegner, K. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). Dec 1987. 12p. NTIS, PC A03/MF A01.

The paper discusses the development and field-testing of the Marine Incineration Biological Assessment Sampler (MIBAS), used to assess potential effects of incinerating hazardous wastes at sea. In 1985, the U.S. EPA developed a strategy for the research necessary for measuring environmental and public health effects of incinerating hazardous wastes at sea. One area of this strategy addressed developing a way to sample incinerator emissions and introduce them into seawater for use as test media in toxicity tests. Responding to the strategy, EPA developed the MIBAS system, a system that samples incineration flue gas, cools the emissions, and collects them in seawater-filled impingers. Particulate matter and both semivolatile and nonvolatile organic species are collected by the train. The sample for use in toxicity tests includes the contents of the impingers, the probe, a flexible Teflon line, and a condenser coil. MIBAS tests have included spike-recovery, using a gas-phase spiking system to spike compounds into the emissions and then measuring them in the components of the MIBAS train.

22692 **(PB—88-133616/XAB) Chemical characterization of polynuclear aromatic hydrocarbon degradation products from sampling artifacts. Final report, 15 September 1986-31 July 1987.** Chuang, J.C.; Hannan, S.W.; Slivon, L.E. (Battelle Columbus Div., OH (USA)). Dec 1987. 77p. NTIS, PC A05/MF A01.

The objective of the study was to characterize the polar components, mainly polynuclear aromatic hydrocarbon (PAH) derivatives, in air samples and to determine whether these compounds are from sampling artifacts or from the sampled air. A literature survey was conducted to review the studies about polar PAH derivatives found in the air. In general, there is limited chemical and biological information for polar PAH available in the literature. The polar fractions of air samples did show a significant amount of mutagenic activity. More studies are needed in the area to determine the polar components responsible for the activity.

22693 **(PB—88-133699/XAB) Supercritical fluid extraction of particulate and adsorbent materials. Part 2. Final report, February 1985-January 1986.** Wright, B.W.; Smith, R.D. (Pacific Northwest Lab., Richland, WA (USA)). Dec 1987. 80p. NTIS, PC A05/MF A01.

See also PB—86-175999.

The physical properties of supercritical fluids allow similar solvent strengths as liquids, but with higher diffusion coefficients, lower viscosities, and an extended temperature range that provides the potential for more-rapid and efficient extraction rates than possible with liquids. The report describes expanded studies conducted to evaluate the applicability and efficiency of analytical supercriti-

cal fluid extraction and related methodologies. These studies included the development of quantitative off-line supercritical fluid extraction methodology and a comparison to traditional Soxhlet extraction, the development and evaluation of on-line supercritical fluid extraction-gas chromatography for combined sample preparation and analysis, and direct supercritical fluid extraction-mass spectrometry for the monitoring of specific extraction profiles as a function of time. The sample matrices included an air particulate sample and XAD-2 resin, polyurethane foam, and Spherocarb adsorbents that were spiked with various model compounds. Carbon dioxide, isobutane, and methanol modified (20 mole %) carbon dioxide were utilized as supercritical fluid systems. Related studies on the evaluation of the quantitative analysis capability of a fluorescence detection supercritical fluid chromatography method and the development of viable solute focusing methods for capillary supercritical fluid chromatography were also conducted.

22694 **(PB—88-134358/XAB) Workshop on evaluation/ documentation of chemical mechanisms. Final report.** Atkinson, R.; Jeffries, H.; Whitten, G.; Lurmann, F. (California Univ., Riverside (USA). Statewide Air Pollution Research Center). Nov 1987. 389p. NTIS, PC A17/MF A01.

Photochemical air-quality models are often questioned for lack of evaluation of the chemical mechanisms used and for inadequate documentation of the chemical mechanism components of the models. In response to these concerns, a workshop was conducted for the purpose of reviewing and critically discussing approaches to evaluating chemical mechanisms and past practices in documenting mechanistic models. A steering committee analyzed workshop presentations and followup discussions and interpreted them in terms of judgments regarding reliability of evaluation/documentation of approaches/practices and recommendations for future research/development. The report includes background planning documents, workshop presentations and followup discussions, and the Steering Committee's conclusions and recommendations.

22695 **(PB—88-134812/XAB) Relationship between air quality and the respiratory status of asthmatics in an area of high oxidant pollution in Los Angeles County (revised). Final report, 1 July 1982-7 April 1986.** Gong, H.; Simmons, M.S.; Tashkin, D.P.; Clark, V.A.; Coulson, A.H. (Maine Dept. of Environmental Protection, Augusta (USA)). 1 Apr 1987. 228p. NTIS, PC A11/MF A01.

Revision of report dated 30 Jan 1986.

This report documents a 230-day study of 83 asthmatics residing in an area of high-oxidant air pollution to evaluate: (1) the potential effects of ambient ozone on daily respiratory symptoms, medication use, and peak expiratory flow rates; and (2) the characteristics of ozone-sensitive subjects. It concludes that the ambient ozone concentrations present during the study were associated with statistically significant changes in the respiratory status of the majority of asthmatic subjects. Although only a small subset of subjects had clinically significant responses to ozone, it speculates that more individuals could have had clinically relevant effects if their asthma and the oxidant air pollution were more severe than present in the study.

22696 **(PB—88-136593/XAB) National Air Toxics Information Clearinghouse: bibliography of selected reports and Federal Register notices related to air toxics. Volume 2. Index.** Owen, C.A.; Hanson, M.L.; Wall, T.M.; Pelland, A.S. (Radian Corp., Research Triangle Park, NC (USA)). Jul 1987. 357p. (DCN—87-239-001-23-09-VOL-2). NTIS, PC A16/MF A01.

See also Volume 1, PB—88-136601.

The National Air Toxics Information Clearinghouse has been established by the EPA Office of Air Quality Planning and Standards for the purpose of facilitating information transfer among Federal, State, and local air-quality-management agencies. The document was published as part of that effort. The purpose is to provide State and local agencies and other Clearinghouse users with citations to reports and Federal Register notices useful in developing and operating air-toxics control programs. The reports selected for the bibliography were published by the following agencies: U.S. Environmental Protection Agency, National Academy of Sciences, National Cancer Institute, National Institute of Environmental Health Sciences, National Toxicology Program, National Institute for Occupational Safety and Health, and World Health Organization. Reports published by various State and local agencies are also included. Volume 2 consists of an index to the reports by document type; pollutant by class, name, or Chemical Abstracts Service (CAS) number; source category by Standard Industrial Classification (SIC) code; and sponsoring agency.

22697 **(PB—88-136601/XAB) National Air Toxics Information Clearinghouse: bibliography of selected reports and Federal Register notices related to air toxics. Volume 1. Citations. Interim report.** Owen, C.A.; Hanson, M.L.; Wall, T.M.; Pelland, A.S. (Radian Corp., Research Triangle Park, NC (USA)). Jul 1987. 541p. (DCN—87-239-001-23-09-VOL-1). NTIS, PC A23/MF A01.

See also Volume 2, PB—88-136593.

This report provides State and local agencies and other Clearinghouse users with citations to reports and Federal Register notices useful in developing and operating air-toxics control programs. The reports selected for the bibliography were published by the following agencies, EPA, NAS, NCI, NIEHS, NTP, NIOSH, and WHO. Reports published by various State and local agencies are also included. The report is published in two volumes. Volume 1, Part 1 includes introductory material describing the scope and organization and contains information necessary for the proper use of the document. Volume 1, Part 2 contains the report and Federal Register notice entries with bibliographic information and, in most cases, an abstract. Volume 2 consists of an index to the reports by document type; pollutant by class, name, or Chemical Abstracts Service (CAS) number; source category by Standard Industrial Classification (SIC) code; and sponsoring agency.

22698 **(PB—88-137138/XAB) Development of the 1980 NAPAP (National Acid Precipitation Assessment Program) Emissions inventory: point sources, Product B (Version 5.0). Data file.** Mobley, J.D.; Zelmanowitz, S. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). 1980. mag tap. (EPA—600/7-86/057B). NTIS CP T03.

See also PB—87-182879; Source tape is in the EBCDIC character set. This restricts preparation to 9 track, one-half inch tape only. Identify recording mode by specifying density only. For price at 6250 bpi density, call NTIS Computer Products. Price includes documentation, PB—88-132121.

The 1980 NAPAP Emissions Inventory point-source emissions data for the 48 contiguous United States are contained in the data file. Annual emissions of 11 pollutants (SO_2, SO_4, NOx, Pb, CO, HCl, HF, NH_3, TSP, VOC, and total hydrocarbons) from 13,769 plants encompassing 34,483 emission points and 50,159 source classification code (SCC) or process level records are present. The data file (Product B) is one of a series of 1980 NAPAP Emissions Inventory products. A report (Development of the 1980 NAPAP Emissions Inventory) documenting the contents of the data file is available as Product A. Other emissions inventory products include data files containing U.S. and Canadian annual point and area source emissions (Version 5.0) and temporally, spatially, and species-resolved emissions for a typical weekday, Saturday, and Sunday in each season (Versions 5.2 and 5.3). Version 5.2 contains total hydrocarbons (THC) speciated into 28 photochemical reactivity classes, while THC in Version 5.3 are speciated into 10 classes based on carbon bond IV chemistry.

22699 **(PB—88-137146/XAB) Development of the 1980 NAPAP (National Precipitation Assessment Program) Emissions Inventory: Canadian point sources, Product C (version 5.0). Data file.** Mobley, J.D.; Zelmanowitz, S. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). 1980. mag tap. (EPA—600/7-86/057C). NTIS CP T02.

See also PB—87-182879; Source tape is in the EBCDIC character set. This restricts preparation to 9 track, one-half inch tape only. Identify recording mode by specifying density only. For price at 6250 bpi density, call NTIS Computer Products. Price includes documentation, PB—88-132121.

The 1980 NAPAP Emissions Inventory point source emissions data for that portion of Canada in the NAPAP study area (east of 125 degrees W. Longitude and south of 60 degrees N. Lati-

tude) are contained in the data file. Annual emissions of 8 pollutants (SO_2, SO_4, NOx, CO, NH_3, TSP, VOC, and total hydrocarbons) from 565 plants encompassing 2324 emission points and 2745 source classification code (SCC) or process level records are present. The data file (Product C) is one of a series of 1980 NAPAP Emissions Inventory products. A report (Development of the 1980 NAPAP Emissions Inventory) documenting the contents of the data file is available as Product A. Other emissions inventory products include data files containing U.S. and Canadian annual point and area source emissions (Version 5.0) and temporally, spatially, and species-resolved emissions for a typical weekday, Saturday, and Sunday in each season (Versions 5.2 and 5.3). Version 5.2 contains total hydrocarbons (THC) speciated into 28 photochemical reactivity classes, while THC in Version 5.3 are speciated into 10 classes based on carbon bond IV chemistry.

22700 **(PB—88-137153/XAB) Development of the 1980 NAPAP (National Acid Precipitation Assessment Program) Emissions Inventory: area sources, Product D (Version 5.0). Data file.** Mobley, J.D.; Zelmonowitz, S. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). 1980. mag tap. (EPA—600/7-86/057D). NTIS CP T10.

See also PB—87-182879; Source tape is in the EBCDIC character set. This restricts preparation to 9 track, one-half inch tape only. Identify recording mode by specifying density only. For price at 6250 bpi density, call NTIS Computer Products.

The 1980 NAPAP Emissions Inventory area source emissions data for the 48 contiguous United States are contained in the data file. Annual emissions of 11 pollutants (SO_2, SO_4, NOx, Pb, CO, HCl, HF, NH_3, TSP, VOC, and total hydrocarbons) from 88 area source categories in 3070 counties are present. The data file (Product D) is one of a series of 1980 NAPAP Emissions Inventory products. A report (Development of the 1980 NAPAP Emissions Inventory) documenting the contents of the data file is available as Product A. Other emissions inventory products include data files containing U.S. and Canadian annual point and area source emissions (Version 5.0) and temporally, spatially, and species-resolved emissions for a typical weekday, Saturday, and Sunday in each season (Versions 5.2 and 5.3). Version 5.2 contains total hydrocarbons (THC) speciated into 28 photochemical reactivity classes, while THC in Version 5.3 are speciated into 10 classes based on carbon bond IV chemistry.

22701 **(PB—88-137161/XAB) Development of the 1980 NAPAP (National Acid Precipitation Assessment Program) Emissions Inventory: Canadian area sources, Product E (version 5.0). Data file.** Mobley, J.D.; Zelmanowitz, S. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). 1980. mag tap. (EPA—600/7-86/057E). NTIS CP T02.

See also PB—87-182879; Source tape is in the EBCDIC character set. This restricts preparation to 9 track, one-half inch tape only. Identify recording mode by specifiying density only. For price at 6250 bpi density, call NTIS Computer Products. Price includes documentation, PB—88-132121.

The 1980 NAPAP Emissions Inventory area source emissions data for that portion of Canada in the NAPAP study area (east of 125 degrees W. Longitude and south of 60 degrees N. Latitude) are contained in the data file. Annual emissions of 8 pollutants (SO_2, SO_4, NOx, CO, NH_3, TSP, VOC, and total hydrocarbons) from 150 area source categories in 10 provinces are present. The data file (Product E) is one of a series of 1980 NAPAP Emissions Inventory products. A report (Development of the 1980 NAPAP Emissions Inventory) documenting the contents of the data file is available as Product A. Other emissions inventory products include data files containing U.S. and Canadian annual point and area source emissions (Version 5.0) and temporally, spatially, and species-resolved emissions for a typical weekday, Saturday, and Sunday in each season (Versions 5.2 and 5.3). Version 5.2 contains total hydrocarbons (THC) speciated into 28 photochemical reactivity classes, while THC in Version 5.3 are speciated into 10 classes based on carbon bond IV chemistry.

22702 **(PB—88-137179/XAB) Development of the 1980 NAPAP (National Acid Precipitation Assessment Program) Emissions Inventory: point sources, Product F (version 5.2). Data file.** Mobley, J.D.; Zelmanowitz, S. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). 1980. mag tap. (EPA—600/7-86/057F). NTIS CP T04.

See also PB—87-182879; Source tape is in the EBCDIC character set. This restricts preparation to 9 track, one-half inch tape only. Identify recording mode by specifying density only. For price at 6250 bpi density, call NTIS Computer Products. Price includes documentation, PB—88-132121.

The 1980 NAPAP Emissions Inventory 5.2 point source emissions data for the 48 contiguous United States and Canada (from 50 degrees to 125 degrees W. Longitude and from 25 degrees to 60 degrees N. Latitude) are contained in the data file. Annual emissions of 11 pollutants (SO_2, SO_4, NOx, Pb, CO, HCl, HF, NH_3, TSP, VOC, and total hydrocarbons) from 14,334 plants encompassing 36,817 emission points and 52,904 source classification code (SCC) or process level records are present. Grid locations and temporal and species allocation factors are also included to allow for spatial, temporal, and species resolution of the data. The data file (Product F) is one of a series of 1980 NAPAP Emissions Inventory products. A report (Development of the 1980 NAPAP Emissions Inventory) documenting the contents of the data file is available as Product A. Other emissions inventory products include data files containing U.S. and Canadian annual point and area source emissions (Version 5.0) and temporally, spatially, and species-resolved emissions for a typical weekday, Saturday, and Sunday in each season (Versions 5.2 and 5.3). Version 5.2 contains total hydrocarbons (THC) speciated into 28 photochemical reactivity classes, while THC in Version 5.3 are speciated into 10 classes based on carbon bond IV chemistry.

22703 **(PB—88-137187/XAB) Development of the 1980 NAPAP (National Acid Precipitation Assessment Program) Emissions Inventory: area source-winter weekday, Product G (version 5.2). Data file.** Mobley, J.D.; Zelmanowitz, S. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). 1980. mag tap. (EPA—600/7-86/057G). NTIS CP T07.

See also PB—87-182879; Source tape is in the EBCDIC character set. This restricts preparation to 9 track, one-half inch tape only. Identify recording mode by specifying density only. For price at 6250 bpi density, call NTIS Computer Products. Price includes documentation, PB—88-132121.

The 1980 NAPAP Emissions Inventory 5.2 area source emissions data for the 48 contiguous United States and Canada (from 50 degrees to 125 degrees W. Longitude and from 25 degrees to 60 degrees N. Latitude) are contained in the data file. Temporally, spatially, and species-resolved emissions of 11 pollutants (SO_2, SO_4, NOx, Pb, CO, HCl, HF, NH_3, TSP, VOC, and total hydrocarbons) for a typical winter weekday for 88 source categories from 3070 U.S. counties and 150 source categories from 10 Canadian provinces are present. The data file (Product G) is one of a series of 1980 NAPAP Emissions Inventory products. A report (Development of the 1980 NAPAP Emissions Inventory) documenting the contents of the data file is available as Product A. Other emissions inventory products include data files containing U.S. and Canadian annual point and area source emissions (Version 5.0) and temporally, spatially, and species-resolved emissions for a typical weekday, Saturday, and Sunday in each season (Versions 5.2 and 5.3). Version 5.2 contains total hydrocarbons (THC) speciated into 28 photochemical reactivity classes, while THC in Version 5.3 are speciated into 10 classes based on carbon bond IV chemistry.

22704 **(PB—88-137195/XAB) Development of the 1980 NAPAP (National Acid Precipitation Assessment Program) Emissions Inventory: area sources-Winter Saturday, Product H (Version 5.2). Data file.** Mobley, J.D.; Zelmanowitz, S. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). 1980. mag tap. (EPA—600/7-86/057H). NTIS CP T07.

See also PB—87-182879; Source tape is in the EBCDIC character set. This restricts preparation to 9 track, one-half inch

tape only. Identify recording mode by specifying density only. For price at 6250 bpi density, call NTIS Computer Products. Price includes documentation, PB—88-132121.

The 1980 NAPAP Emissions Inventory 5.2 area source emissions data for the 48 contiguous United States and Canada (from 50 degrees to 125 degrees W. Longitude and from 25 degrees to 60 degrees N. Latitude) are contained in the data file. Temporally, spatially, and species-resolved emissions of 11 pollutants (SO_2, SO_4, NOx, Pb, CO, HCl, HF, NH_3, TSP, VOC, and total hydrocarbons) for a typical winter Saturday for 88 source categories from 3070 U.S. counties and 150 source categories from 10 Canadian provinces are present. The data file (Product H) is one of a series of 1980 NAPAP Emissions Inventory products. A report (Development of the 1980 NAPAP Emissions Inventory) documenting the contents of the data file is available as Product A. Other emissions inventory products include data files containing U.S. and Canadian annual point and area source emissions (Version 5.0) and temporally, spatially, and species-resolved emissions for a typical weekday, Saturday, and Sunday in each season (Versions 5.2 and 5.3). Version 5.2 contains total hydrocarbons (THC) speciated into 28 photochemical reactivity classes, while THC in Version 5.3 are speciated into 10 classes based on carbon bond IV chemistry.

22705 (PB—88-137203/XAB) Development of the 1980 NAPAP (National Acid Precipitation Assessment Program) Emissions Inventory: area sources-Winter Sunday, Product I (version 5.2). Data file. Mobley, J.D.; Zelmanowitz, S. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). 1980. mag tap. (EPA—600/7-86/057I). NTIS CP T07.

See also PB—87-182879; Source tape is in the EBCDIC character set. This restricts preparation to 9 track, one-half inch tape only. Identify recording mode by specifying density only. For price at 6250 bpi density, call NTIS Computer Products. Price includes documentation, PB—88-132121.

The 1980 NAPAP Emissions Inventory 5.2 area source emissions data for the 48 contiguous United States and Canada (from 50 degrees to 125 degrees W. Longitude and from 25 degrees to 60 degrees N. Latitude) are contained in the data file. Temporally, spatially, and species-resolved emissions of 11 pollutants (SO_2, SO_4, NOx, Pb, CO, HCl, HF, NH_3, TSP, VOC, and total hydrocarbons) for a typical winter Sunday for 88 source categories from 3070 U.S. counties and 150 source categories from 10 Canadian provinces are present. The data file (Product I) is one of a series of 1980 NAPAP Emissions Inventory products. A report (Development of the 1980 NAPAP Emissions Inventory) documenting the contents of the data file is available as Product A. Other emissions inventory products include data files containing U.S. and Canadian annual point and area source emissions (Version 5.0) and temporally, spatially, and species-resolved emissions for a typical weekday, Saturday, and Sunday in each season (Versions 5.2 and 5.3). Version 5.2 contains total hydrocarbons (THC) speciated into 28 photochemical reactivity classes, while THC in Version 5.3 are speciated into 10 classes based on carbon bond IV chemistry.

22706 (PB—88-137211/XAB) Development of the 1980 NAPAP (National Acid Precipitation Assessment Program) Emissions Inventory: area sources-Spring weekday, Product J (version 5.2). Data file. Mobley, J.D.; Zelmanowitz, S. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). 1980. mag tap. (EPA—600/7-86/057J). NTIS CP T07.

See also PB—87-182879; Source tape is in the EBCDIC character set. This restricts preparation to 9 track, one-half inch tape only. Identify recording mode by specifying density only. For price at 6250 bpi density, call NTIS Computer Products. Price includes documentation, PB—88-132121.

The 1980 NAPAP Emissions Inventory 5.2 area source emissions data for the 48 contiguous United States and Canada (from 50 degrees to 125 degrees W. Longitude and from 25 degrees to 60 degrees N. Latitude) are contained in the data file. Temporally, spatially, and species-resolved emissions of 11 pollutants (SO_2, SO_4, NOx, Pb, CO, HCl, HF, NH_3, TSP, VOC, and total hydrocarbons) for a typical spring weekday for 88 source categories from 3070 U.S. counties and 150 source categories from 10 Canadian provinces are present. The data file (Product J) is one of a series of 1980 NAPAP Emissions Inventory products. A report (Development of the 1980 NAPAP Emissions Inventory) documenting the contents of the data file is available as Product A. Other emissions inventory products include data files containing U.S. and Canadian annual point and area source emissions (Version 5.0) and temporally, spatially, and species-resolved emissions for a typical weekday, Saturday, and Sunday in each season (Versions 5.2 and 5.3). Version 5.2 contains total hydrocarbons (THC) speciated into 28 photchemical reactivity classes, while THC in Version 5.3 are speciated into 10 classes based on carbon bond IV chemistry.

22707 (PB—88-137229/XAB) Development of the 1980 NAPAP (National Acid Precipitation Assessment Program) Emissions Inventory: area sources-Spring Saturday, Product K (version 5.2). Data file. Mobley, J.D.; Zelmanowitz, S. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). 1980. mag tap. (EPA—600/7-86/057K). NTIS CP T07.

See also PB—87-182879; Source tape is in the EBCDIC character set. This restricts preparation to 9 track, one-half inch tape only. Identify recording mode by specifying density only. For price at 6250 bpi density, call NTIS Computer Products. Price includes documentation, PB—88-132121.

The 1980 NAPAP Emissions Inventory 5.2 area source emissions data for the 48 contiguous United States and Canada (from 50 degrees to 125 degrees W. Longitude and from 25 degrees to 60 degrees N. Latitude) are contained in the data file. Temporally, spatially, and species-resolved emissions of 11 pollutants (SO_2, SO_4, NOx, Pb, CO, HCl, HF, NH_3, TSP, VOC, and total hydrocarbons) for a typical spring weekday for 88 source categories from 3070 U.S. counties and 150 source categories from 10 Canadian provinces are present. The data file (Product K) is one of a series of 1980 NAPAP Emissions Inventory products. A report (Development of the 1980 NAPAP Emissions Inventory) documenting the contents of the data file is available as Product A. Other emissions inventory products include data files containing U.S. and Canadian annual point and area source emissions (Version 5.0) and temporally, spatially, and species-resolved emissions for a typical weekday, Saturday, and Sunday in each season (Versions 5.2 and 5.3). Version 5.2 contains total hydrocarbons (THC) speciated into 28 photchemical reactivity classes, while THC in Version 5.3 are speciated into 10 classes based on carbon bond IV chemistry.

22708 (PB—88-137237/XAB) Development of the 1980 NAPAP (National Acid Precipitation Assessment Program) Emissions Inventory: area sources-Spring Sunday, Product L (version 5.2). Data file. Mobley, J.D.; Zelmanowitz, S. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). 1980. mag tap. (EPA—600/7-86/057L). NTIS CP T07.

See also PB—87-182879; Source tape is in the EBCDIC character set. This restricts preparation to 9 track, one-half inch tape only. Identify recording mode by specifying density only. For price at 6250 bpi density, call NTIS Computer Products. Price includes documentation, PB—88-132121.

The 1980 NAPAP Emissions Inventory 5.2 area source emissions data for the 48 contiguous United States and Canada (from 50 degrees to 125 degrees W. Longitude and from 25 degrees to 60 degrees N. Latitude) are contained in the data file. Temporally, spatially, and species-resolved emissions of 11 pollutants (SO_2, SO_4, NOx, Pb, CO, HCl, HF, NH_3, TSP, VOC, and total hydrocarbons) for a typical spring weekday for 88 source categories from 3070 U.S. counties and 150 source categories from 10 Canadian provinces are present. The data file (Product L) is one of a series of 1980 NAPAP Emissions Inventory products. A report (Development of the 1980 NAPAP Emissions Inventory) documenting the contents of the data file is available as Product A. Other emissions inventory products include data files containing U.S. and Canadian annual point and area source emissions (Version 5.0) and temporally, spatially, and species-resolved emissions for a typical weekday, Saturday, and Sunday in each season (Versions 5.2 and 5.3). Version 5.2 contains total hydrocarbons (THC) speciated into 28 photchemical reactivity classes, while THC in Version 5.3 are speciated into 10 classes based on carbon bond IV chemistry.

22709 **(PB—88-137245/XAB) Development of the 1980 NAPAP (National Acid Precipitation Assessment Program) Emissions Inventory: area sources-Summer weekday, Product M (Version 5.2). Data file.** Mobley, J.D.; Zelmanowitz, S. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). 1980. mag tap. (EPA—600/7-86/057M). NTIS CP T07.

See also PB—87-182879; Source tape is in the EBCDIC character set. This restricts preparation to 9 track, one-half inch tape only. Identify recording mode by specifying density only. For price at 6250 bpi density, call NTIS Computer Products. Price includes documentation, PB—88-132121.

The 1980 NAPAP Emissions Inventory 5.2 area source emissions data for the 48 contiguous United States and Canada (from 50 degrees to 125 degrees W. Longitude and from 25 degrees to 60 degrees N. Latitude) are contained in the data file. Temporally, spatially, and species-resolved emissions of 11 pollutants (SO_2, SO_4, NOx, Pb, CO, HCl, HF, NH_3, TSP, VOC, and total hydrocarbons) for a typical spring weekday for 88 source categories from 3070 U.S. counties and 150 source categories from 10 Canadian provinces are present. The data file (Product M) is one of a series of 1980 NAPAP Emissions Inventory products. A report (Development of the 1980 NAPAP Emissions Inventory) documenting the contents of the data file is available as Product A. Other emissions inventory products include data files containing U.S. and Canadian annual point and area source emissions (Version 5.0) and temporally, spatially, and species-resolved emissions for a typical weekday, Saturday, and Sunday in each season (Versions 5.2 and 5.3). Version 5.2 contains total hydrocarbons (THC) speciated into 28 photchemical reactivity classes, while THC in Version 5.3 are speciated into 10 classes based on carbon bond IV chemistry.

22710 **(PB—88-137252/XAB) Development of the 1980 NAPAP (National Acid Precipitation Assessment Program) Emissions Inventory: area sources-Summer Saturday, Product N (version 5.2). Data file.** Mobley, J.D.; Zelmanowitz, S. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). 1980. mag tap. (EPA—600/7-86/057N). NTIS CP T07.

See also PB—87-182879; Source tape is in the EBCDIC character set. This restricts preparation to 9 track, one-half inch tape only. Identify recording mode by specifying density only. For price at 6250 bpi density, call NTIS Computer Products. Price includes documentation, PB—88-132121.

The 1980 NAPAP Emissions Inventory 5.2 area source emissions data for the 48 contiguous United States and Canada (from 50 degrees to 125 degrees W. Longitude and from 25 degrees to 60 degrees N. Latitude) are contained in the data file. Temporally, spatially, and species-resolved emissions of 11 pollutants (SO_2, SO_4, NOx, Pb, CO, HCl, HF, NH_3, TSP, VOC, and total hydrocarbons) for a typical spring weekday for 88 source categories from 3070 U.S. counties and 150 source categories from 10 Canadian provinces are present. The data file (Product N) is one of a series of 1980 NAPAP Emissions Inventory products. A report (Development of the 1980 NAPAP Emissions Inventory) documenting the contents of the data file is available as Product A. Other emissions inventory products include data files containing U.S. and Canadian annual point and area source emissions (Version 5.0) and temporally, spatially, and species-resolved emissions for a typical weekday, Saturday, and Sunday in each season (Versions 5.2 and 5.3). Version 5.2 contains total hydrocarbons (THC) speciated into 28 photchemical reactivity classes, while THC in Version 5.3 are speciated into 10 classes based on carbon bond IV chemistry.

22711 **(PB—88-137260/XAB) Development of the 1980 NAPAP (National Acid Precipitation Assessment Program) Emissions Inventory: area sources-Summer Sunday, Product O (Version 5.2). Data file.** Mobley, J.D.; Zelmanowitz, S. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). 1980. mag tap. (EPA—600/7-86/057O). NTIS CP T07.

See also PB—87-182879; Source tape is in the EBCDIC character set. This restricts preparation to 9 track, one-half inch tape only. Identify recording mode by specifying density only. For price at 6250 bpi density, call NTIS Computer Products. Price includes documentation, PB—88-132121.

The 1980 NAPAP Emissions Inventory 5.2 area source emissions data for the 48 contiguous United States and Canada (from 50 degrees to 125 degrees W. Longitude and from 25 degrees to 60 degrees N. Latitude) are contained in the data file. Temporally, spatially, and species-resolved emissions of 11 pollutants (SO_2, SO_4, NOx, Pb, CO, HCl, HF, NH_3, TSP, VOC, and total hydrocarbons) for a typical spring weekday for 88 source categories from 3070 U.S. counties and 150 source categories from 10 Canadian provinces are present. The data file (Product O) is one of a series of 1980 NAPAP Emissions Inventory products. A report (Development of the 1980 NAPAP Emissions Inventory) documenting the contents of the data file is available as Product A. Other emissions inventory products include data files containing U.S. and Canadian annual point and area source emissions (Version 5.0) and temporally, spatially, and species-resolved emissions for a typical weekday, Saturday, and Sunday in each season (Versions 5.2 and 5.3). Version 5.2 contains total hydrocarbons (THC) speciated into 28 photchemical reactivity classes, while THC in Version 5.3 are speciated into 10 classes based on carbon bond IV chemistry.

22712 **(PB—88-137278/XAB) Development of the 1980 NAPAP (National Acid Precipitation Assessment Program) Emissions Inventory: area sources-Fall weekday, Product P (Version 5.2). Data file.** Mobley, J.D.; Zelmanowitz, S. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). 1980. mag tap. (EPA—600/7-86/057P). NTIS CP T07.

See also PB—87-182879; Source tape is in the EBCDIC character set. This restricts preparation to 9 track, one-half inch tape only. Identify recording mode by specifying density only. For price at 6250 bpi density, call NTIS Computer Products. Price includes documentation, PB—88-132121.

The 1980 NAPAP Emissions Inventory 5.2 area source emissions data for the 48 contiguous United States and Canada (from 50 degrees to 125 degrees W. Longitude and from 25 degrees to 60 degrees N. Latitude) are contained in the data file. Temporally, spatially, and species-resolved emissions of 11 pollutants (SO_2, SO_4, NOx, Pb, CO, HCl, HF, NH_3, TSP, VOC, and total hydrocarbons) for a typical spring weekday for 88 source categories from 3070 U.S. counties and 150 source categories from 10 Canadian provinces are present. The data file (Product P) is one of a series of 1980 NAPAP Emissions Inventory products. A report (Development of the 1980 NAPAP Emissions Inventory) documenting the contents of the data file is available as Product A. Other emissions inventory products include data files containing U.S. and Canadian annual point and area source emissions (Version 5.0) and temporally, spatially, and species-resolved emissions for a typical weekday, Saturday, and Sunday in each season (Versions 5.2 and 5.3). Version 5.2 contains total hydrocarbons (THC) speciated into 28 photochemical reactivity classes, while THC in Version 5.3 are speciated into 10 classes based on carbon bond IV chemistry.

22713 **(PB—88-137286/XAB) Development of the 1980 NAPAP (National Acid Precipitation Assessment Program) Emissions Inventory: area sources-Fall Saturday, Product Q (Version 5.2).** Mobley, J.D.; Zelmanowitz, S. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). 1980. mag tap. (EPA—600/7-86/057Q). NTIS CP T07.

See also PB—87-182879; Source tape is in the EBCDIC character set. This restricts preparation to 9 track, one-half inch tape only. Identify recording mode by specifying density only. For price at 6250 bpi density, call NTIS Computer Products. Price includes documentation, PB—88-132121.

The 1980 NAPAP Emissions Inventory 5.2 area source emissions data for the 48 contiguous United States and Canada (from 50 degrees to 125 degrees W. Longitude and from 25 degrees to 60 degrees N. Latitude) are contained in the data file. Temporally, spatially, and species-resolved emissions of 11 pollutants (SO_2, SO_4, NOx, Pb, CO, HCl, HF, NH_3, TSP, VOC, and total hydrocarbons) for a typical spring weekday for 88 source categories from 3070 U.S. counties and 150 source categories from 10 Canadian provinces are present. The data file (Product Q) is one of a series of 1980 NAPAP Emissions Inventory products. A report (Develop-

ment of the 1980 NAPAP Emissions Inventory) documenting the contents of the data file is available as Product A. Other emissions inventory products include data files containing U.S. and Canadian annual point and area source emissions (Version 5.0) and temporally, spatially, and species-resolved emissions for a typical weekday, Saturday, and Sunday in each season (Versions 5.2 and 5.3). Version 5.2 contains total hydrocarbons (THC) speciated into 28 photochemical reactivity classes, while THC in Version 5.3 are speciated into 10 classes based on carbon bond IV chemistry.

22714 **(PB—88-137294/XAB) Development of the 1980 NAPAP (National Acid Precipitation Assessment Program) Emissions Inventory: area sources-Fall Sunday, Product R (Version 5.2). Data file.** Mobley, J.D.; Zelmanowitz, S. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). 1980. mag tap. (EPA—600/7-86/057R). NTIS CP T07.

See also PB—87-182879; Source tape is in the EBCDIC character set. This restricts preparation to 9 track, one-half inch tape only. Identify recording mode by specifying density only. For price at 6250 bpi density, call NTIS Computer Products. Price includes documentation, PB—88-132121.

The 1980 NAPAP Emissions Inventory 5.2 area source emissions data for the 48 contiguous United States and Canada (from 50 degrees to 125 degrees W. Longitude and from 25 degrees to 60 degrees N. Latitude) are contained in the data file. Temporally, spatially, and species-resolved emissions of 11 pollutants (SO_2, SO_4, NOx, Pb, CO, HCl, HF, NH_3, TSP, VOC, and total hydrocarbons) for a typical spring weekday for 88 source categories from 3070 U.S. counties and 150 source categories from 10 Canadian provinces are present. The data file (Product R) is one of a series of 1980 NAPAP Emissions Inventory products. A report (Development of the 1980 NAPAP Emissions Inventory) documenting the contents of the data file is available as Product A. Other emissions inventory products include data files containing U.S. and Canadian annual point and area source emissions (Version 5.0) and temporally, spatially, and species-resolved emissions for a typical weekday, Saturday, and Sunday in each season (Versions 5.2 and 5.3). Version 5.2 contains total hydrocarbons (THC) speciated into 28 photochemical reactivity classes, while THC in Version 5.3 are speciated into 10 classes based on carbon bond IV chemistry.

22715 **(PB—88-137302/XAB) Development of the 1980 NAPAP (National Acid Precipitation Assessment Program) Emissions Inventory: point sources, Product S (Version 5.3). Data file.** Mobley, J.D.; Zelmanowitz, S. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). 1980. mag tap. (EPA—600/7-86/057S). NTIS CP T03.

See also PB—87-182879; Source tape is in the EBCDIC character set. This restricts preparation to 9 track, one-half inch tape only. Identify recording mode by specifying density only. For price at 6250 bpi density, call NTIS Computer Products. Price includes documentation, PB—88-132121.

The 1980 NAPAP Emissions Inventory 5.2 area source emissions data for the 48 contiguous United States and Canada (from 50 degrees to 125 degrees W. Longitude and from 25 degrees to 60 degrees N. Latitude) are contained in the data file. Temporally, spatially, and species-resolved emissions of 11 pollutants (SO_2, SO_4, NOx, Pb, CO, HCl, HF, NH_3, TSP, VOC, and total hydrocarbons) for a typical spring weekday for 88 source categories from 3070 U.S. counties and 150 source categories from 10 Canadian provinces are present. The data file (Product S) is one of a series of 1980 NAPAP Emissions Inventory products. A report (Development of the 1980 NAPAP Emissions Inventory) documenting the contents of the data file is available as Product A. Other emissions inventory products include data files containing U.S. and Canadian annual point and area source emissions (Version 5.0) and temporally, spatially, and species-resolved emissions for a typical weekday, Saturday, and Sunday in each season (Versions 5.2 and 5.3). Version 5.2 contains total hydrocarbons (THC) speciated into 28 photochemical reactivity classes, while THC in Version 5.3 are speciated into 10 classes based on carbon bond IV chemistry.

22716 **(PB—88-137310/XAB) Development of the 1980 NAPAP (National Acid Precipitation Assessment Program) Emissions Inventory: area sources-Winter weekday, Product T (Version 5.3). Data file.** Mobley, J.D.; Zelmanowitz, S. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). 1980. mag tap. (EPA—600/7-86/057T). NTIS CP T05.

See also PB—87-182879; Source tape is in the EBCDIC character set. This restricts preparation to 9 track, one-half inch tape only. Identify recording mode by specifying density only. For price at 6250 bpi density, call NTIS Computer Products. Price includes documentation, PB—88-132121.

The 1980 NAPAP Emissions Inventory 5.2 area source emissions data for the 48 contiguous United States and Canada (from 50 degrees to 125 degrees W. Longitude and from 25 degrees to 60 degrees N. Latitude) are contained in the data file. Temporally, spatially, and species-resolved emissions of 11 pollutants (SO_2, SO_4, NOx, Pb, CO, HCl, HF, NH_3, TSP, VOC, and total hydrocarbons) for a typical spring weekday for 88 source categories from 3070 U.S. counties and 150 source categories from 10 Canadian provinces are present. The data file (Product T) is one of a series of 1980 NAPAP Emissions Inventory products. A report (Development of the 1980 NAPAP Emissions Inventory) documenting the contents of the data file is available as Product A. Other emissions inventory products include data files containing U.S. and Canadian annual point and area source emissions (Version 5.0) and temporally, spatially, and species-resolved emissions for a typical weekday, Saturday, and Sunday in each season (Versions 5.2 and 5.3). Version 5.2 contains total hydrocarbons (THC) speciated into 28 photochemical reactivity classes, while THC in Version 5.3 are speciated into 10 classes based on carbon bond IV chemistry.

22717 **(PB—88-137328/XAB) Development of the 1980 NAPAP (National Acid Precipitation Assessment Program) Emissions Inventory: area sources-Winter Saturday, Product U (Version 5.3). Data file.** Mobley, J.D.; Zelmanowitz, S. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). 1980. mag tap. (EPA—600/7-86/057U). NTIS CP T05.

See also PB—87-182879; Source tape is in the EBCDIC character set. This restricts preparation to 9 track, one-half inch tape only. Identify recording mode by specifying density only. For price at 6250 bpi density, call NTIS Computer Products. Price includes documentation, PB—88-132121.

The 1980 NAPAP Emissions Inventory 5.2 area source emissions data for the 48 contiguous United States and Canada (from 50 degrees to 125 degrees W. Longitude and from 25 degrees to 60 degrees N. Latitude) are contained in the data file. Temporally, spatially, and species-resolved emissions of 11 pollutants (SO_2, SO_4, NOx, Pb, CO, HCl, HF, NH_3, TSP, VOC, and total hydrocarbons) for a typical spring weekday for 88 source categories from 3070 U.S. counties and 150 source categories from 10 Canadian provinces are present. The data file (Product U) is one of a series of 1980 NAPAP Emissions Inventory products. A report (Development of the 1980 NAPAP Emissions Inventory) documenting the contents of the data file is available as Product A. Other emissions inventory products include data files containing U.S. and Canadian annual point and area source emissions (Version 5.0) and temporally, spatially, and species-resolved emissions for a typical weekday, Saturday, and Sunday in each season (Versions 5.2 and 5.3). Version 5.2 contains total hydrocarbons (THC) speciated into 28 photochemical reactivity classes, while THC in Version 5.3 are speciated into 10 classes based on carbon bond IV chemistry.

22718 **(PB—88-137336/XAB) Development of the 1980 NAPAP (National Acid Precipitation Assessment Program) Emissions Inventory: area sources-Winter Sunday, Product V (version 5.3). Data file.** Mobley, J.D.; Zelmanowitz, S. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). 1980. mag tap. (EPA—600/7-86/057V). NTIS CP T05.

See also PB—87-182879; Source tape is in the EBCDIC character set. This restricts preparation to 9 track, one-half inch tape only. Identify recording mode by specifying density only. For

price at 6250 bpi density, call NTIS Computer Products. Price includes documentation, PB—88-132121.

The 1980 NAPAP Emissions Inventory 5.2 area source emissions data for the 48 contiguous United States and Canada (from 50 degrees to 125 degrees W. Longitude and from 25 degrees to 60 degrees N. Latitude) are contained in the data file. Temporally, spatially, and species-resolved emissions of 11 pollutants (SO_2, SO_4, NOx, Pb, CO, HCl, HF, NH_3, TSP, VOC, and total hydrocarbons) for a typical spring weekday for 88 source categories from 3070 U.S. counties and 150 source categories from 10 Canadian provinces are present. The data file (Product W) is one of a series of 1980 NAPAP Emissions Inventory products. A report (Development of the 1980 NAPAP Emissions Inventory) documenting the contents of the data file is available as Product A. Other emissions inventory products include data files containing U.S. and Canadian annual point and area source emissions (Version 5.0) and temporally, spatially, and species-resolved emissions for a typical weekday, Saturday, and Sunday in each season (Versions 5.2 and 5.3). Version 5.2 contains total hydrocarbons (THC) speciated into 28 photochemical reactivity classes, while THC in Version 5.3 are speciated into 10 classes based on carbon bond IV chemistry.

22719 **(PB—88-137344/XAB) Development of the 1980 NAPAP (National Acid Precipitation Assessment Program) Emissions Inventory: area sources-Spring Weekday, Product W (version 5.3). Data file.** Mobley, J.D.; Zelmanowitz, S. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). 1980. mag tap. (EPA—600/7-86/057W). NTIS CP T05.

See also PB—87-182879; Source tape is in the EBCDIC character set. This restricts preparation to 9 track, one-half inch tape only. Identify recording mode by specifying density only. For price at 6250 bpi density, call NTIS Computer Products. Price includes documentation, PB—88-132121.

In 1980 NAPAP Emissions Inventory 5.3 area source emissions data for the 48 contiguous United States and Canada (from 50 degrees to 125 degrees W. Longitude and from 25 degrees to 60 degrees N. Latitude) are contained in the data file. Temporally, spatially, and species-resolved emissions of 11 pollutants (SO_2, SO_4, NOx, Pb, CO, HCl, HF, NH_3, TSP, VOC, and total hydrocarbons) for a typical spring weekday for 88 source categories from 3070 U.S. counties and 150 source categories from 10 Canadian provinces are present. The data file (Product W) is one of a series of 1980 NAPAP Emissions Inventory products. A report (Development of the 1980 NAPAP Emissions Inventory) documenting the contents of the data file is available as Product A. Other emissions inventory products include data files containing U.S. and Canadian annual point and area source emissions (Version 5.0) and temporally, spatially, and species-resolved emissions for a typical weekday, Saturday, and Sunday in each season (Versions 5.2 and 5.3). Version 5.2 contains total hydrocarbons (THC) speciated into 28 photochemical reactivity classes, while THC in Version 5.3 are speciated into 10 classes based on carbon bond IV chemistry.

22720 **(PB—88-137351/XAB) Development of the 1980 NAPAP (National Acid Precipitation Assessment Program) Emissions Inventory: area sources-Spring Saturday, Product X (Version 5.3). Data file.** Mobley, J.D.; Zelmanowitz, S. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). 1980. mag tap. (EPA—600/7-86/057X). NTIS CP T05.

See also PB—87-182879; Source tape is in the EBCDIC character set. This restricts preparation to 9 track, one-half inch tape only. Identify recording mode by specifying density only. For price at 6250 bpi density, call NTIS Computer Products. Price includes documentation, PB—88-132121.

The 1980 NAPAP Emissions Inventory 5.2 area source emissions data for the 48 contiguous United States and Canada (from 50 degrees to 125 degrees W. Longitude and from 25 degrees to 60 degrees N. Latitude) are contained in the data file. Temporally, spatially, and species-resolved emissions of 11 pollutants (SO_2, SO_4, NOx, Pb, CO, HCl, HF, NH_3, TSP, VOC, and total hydrocarbons) for a typical spring weekday for 88 source categories from 3070 U.S. counties and 150 source categories from 10 Canadian provinces are present. The data file (Product X) is one of a series of 1980 NAPAP Emissions Inventory products. A report (Development of the 1980 NAPAP Emissions Inventory) documenting the contents of the data file is available as Product A. Other emissions inventory products include data files containing U.S. and Canadian annual point and area source emissions (Version 5.0) and temporally, spatially, and species-resolved emissions for a typical weekday, Saturday, and Sunday in each season (Versions 5.2 and 5.3). Version 5.2 contains total hydrocarbons (THC) speciated into 28 photochemical reactivity classes, while THC in Version 5.3 are speciated into 10 classes based on carbon bond IV chemistry.

22721 **(PB—88-137369/XAB) Development of the 1980 NAPAP (National Acid Precipitation Assessment Program) Emissions Inventory: area sources-Spring Sunday, Product Y (Version 5.3). Data file.** Mobley, J.D.; Zelmanowitz, S. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). 1980. mag tap. (EPA—600/7-86/057Y). NTIS CP T05.

See also PB—87-182879; Source tape is in the EBCDIC character set. This restricts preparation to 9 track, one-half inch tape only. Identify recording mode by specifying density only. For price at 6250 bpi density, call NTIS Computer Products. Price includes documentation, PB—88-132121.

The 1980 NAPAP Emissions Inventory 5.2 area source emissions data for the 48 contiguous United States and Canada (from 50 degrees to 125 degrees W. Longitude and from 25 degrees to 60 degrees N. Latitude) are contained in the data file. Temporally, spatially, and species-resolved emissions of 11 pollutants (SO_2, SO_4, NOx, Pb, CO, HCl, HF, NH_3, TSP, VOC, and total hydrocarbons) for a typical spring weekday for 88 source categories from 3,070 U.S. counties and 150 source categories from 10 Canadian provinces are present. The data file (Product Y) is one of a series of 1980 NAPAP Emissions Inventory products. A report (Development of the 1980 NAPAP Emissions Inventory) documenting the contents of the data file is available as Product A. Other emissions inventory products include data files containing U.S. and Canadian annual point and area source emissions (Version 5.0) and temporally, spatially, and species-resolved emissions for a typical weekday, Saturday, and Sunday in each season (Versions 5.2 and 5.3). Version 5.2 contains total hydrocarbons (THC) speciated into 28 photochemical reactivity classes, while THC in Version 5.3 are speciated into 10 classes based on carbon bond IV chemistry.

22722 **(PB—88-137377/XAB) Development of the 1980 NAPAP (National Acid Precipitation Assessment Program) Emissions Inventory: area sources-Summer weekday, Product Z (Version 5.3). Data file.** Mobley, J.D.; Zelmanowitz, S. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). 1980. mag tap. (EPA—600/7-86/057Z). NTIS CP T05.

See also PB—87-182879; Source tape is in the EBCDIC character set. This restricts preparation to 9 track, one-half inch tape only. Identify recording mode by specifying density only. For price at 6250 bpi density, call NTIS Computer Products. Price includes documentation, PB—88-132121.

The 1980 NAPAP Emissions Inventory 5.2 area source emissions data for the 48 contiguous United States and Canada (from 50 degrees to 125 degrees W. Longitude and from 25 degrees to 60 degrees N. Latitude) are contained in the data file. Temporally, spatially, and species-resolved emissions of 11 pollutants (SO_2, SO_4, NOx, Pb, CO, HCl, HF, NH_3, TSP, VOC, and total hydrocarbons) for a typical spring weekday for 88 source categories from 3070 U.S. counties and 150 source categories from 10 Canadian provinces are present. The data file (Product Z) is one of a series of 1980 NAPAP Emissions Inventory products. A report (Development of the 1980 NAPAP Emissions Inventory) documenting the contents of the data file is available as Product A. Other emissions inventory products include data files containing U.S. and Canadian annual point and area source emissions (Version 5.0) and temporally, spatially, and species-resolved emissions for a typical weekday, Saturday, and Sunday in each season (Versions 5.2 and 5.3). Version 5.2 contains total hydrocarbons (THC) speciated into 28 photochemical reactivity classes, while THC in Version 5.3 are speciated into 10 classes based on carbon bond IV chemistry.

22723 **(PB—88-137385/XAB) Development of the 1980 NAPAP (National Acid Precipitation Assessment Program) Emissions Inventory: area sources-Summer Saturday, Product AA (Version 5.3). Data file.** Mobley, J.D.; Zelmanowitz, S. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). 1980. mag tap. (EPA—600/7-86/057AA). NTIS CP T05.

See also PB—87-182879; Source tape is in the EBCDIC character set. This restricts preparation to 9 track, one-half inch tape only. Identify recording mode by specifying density only. For price at 6250 bpi density, call NTIS Computer Products. Price includes documentation, PB—88-132121.

The 1980 NAPAP Emissions Inventory 5.2 area source emissions data for the 48 contiguous United States and Canada (from 50 degrees to 125 degrees W. Longitude and from 25 degrees to 60 degrees N. Latitude) are contained in the data file. Temporally, spatially, and species-resolved emissions of 11 pollutants (SO_2, SO_4, NOx, Pb, CO, HCl, HF, NH_3, TSP, VOC, and total hydrocarbons) for a typical spring weekday for 88 source categories from 3070 U.S. counties and 150 source categories from 10 Canadian provinces are present. The data file (Product AA) is one of a series of 1980 NAPAP Emissions Inventory products. A report (Development of the 1980 NAPAP Emissions Inventory) documenting the contents of the data file is available as Product A. Other emissions inventory products include data files containing U.S. and Canadian annual point and area source emissions (Version 5.0) and temporally, spatially, and species-resolved emissions for a typical weekday, Saturday, and Sunday in each season (Versions 5.2 and 5.3). Version 5.2 contains total hydrocarbons (THC) speciated into 28 photochemical reactivity classes, while THC in Version 5.3 are speciated into 10 classes based on carbon bond IV chemistry.

22724 **(PB—88-137393/XAB) Development of the 1980 NAPAP (National Acid Precipitation Assessment Program) Emissions Inventory: area sources-Summer Sunday, Product BB (Version 5.3). Data file.** Mobley, J.D.; Zelmanowitz, S. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). 1980. mag tap. (EPA—600/7-86/057BB). NTIS CP T05.

See also PB—87-182879; Source tape is in the EBCDIC character set. This restricts preparation to 9 track, one-half inch tape only. Identify recording mode by specifying density only. For price at 6250 bpi density, call NTIS Computer Products. Price includes documentation, PB—88-132121.

The 1980 NAPAP Emissions Inventory 5.2 area source emissions data for the 48 contiguous United States and Canada (from 50 degrees to 125 degrees W. Longitude and from 25 degrees to 60 degrees N. Latitude) are contained in the data file. Temporally, spatially, and species-resolved emissions of 11 pollutants (SO_2, SO_4, NOx, Pb, CO, HCl, HF, NH_3, TSP, VOC, and total hydrocarbons) for a typical spring weekday for 88 source categories from 3070 U.S. counties and 150 source categories from 10 Canadian provinces are present. The data file (Product BB) is one of a series of 1980 NAPAP Emissions Inventory products. A report (Development of the 1980 NAPAP Emissions Inventory) documenting the contents of the data file is available as Product A. Other emissions inventory products include data files containing U.S. and Canadian annual point and area source emissions (Version 5.0) and temporally, spatially, and species-resolved emissions for a typical weekday, Saturday, and Sunday in each season (Versions 5.2 and 5.3). Version 5.2 contains total hydrocarbons (THC) speciated into 28 photochemical reactivity classes, while THC in Version 5.3 are speciated into 10 classes based on carbon bond IV chemistry.

22725 **(PB—88-137401/XAB) Development of the 1980 NAPAP (National Acid Precipitation Assessment Program) Emissions Inventory: area sources-Fall weekday, Product CC (Version 5.3). Data file.** Mobley, J.D.; Zelmanowitz, S. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). 1980. mag tap. (EPA—600/7-86/057CC). NTIS CP T05.

See also PB—87-182879; Source tape is in the EBCDIC character set. This restricts preparation to 9 track, one-half inch tape only. Identify recording mode by specifying density only. For price at 6250 bpi density, call NTIS Computer Products. Price includes documentation, PB—88-132121.

The 1980 NAPAP Emissions Inventory 5.2 area source emissions data for the 48 contiguous United States and Canada (from 50 degrees to 125 degrees W. Longitude and from 25 degrees to 60 degrees N. Latitude) are contained in the data file. Temporally, spatially, and species-resolved emissions of 11 pollutants (SO_2, SO_4, NOx, Pb, CO, HCl, HF, NH_3, TSP, VOC, and total hydrocarbons) for a typical spring weekday for 88 source categories from 3070 U.S. counties and 150 source categories from 10 Canadian provinces are present. The data file (Product CC) is one of a series of 1980 NAPAP Emissions Inventory products. A report (Development of the 1980 NAPAP Emissions Inventory) documenting the contents of the data file is available as Product A. Other emissions inventory products include data files containing U.S. and Canadian annual point and area source emissions (Version 5.0) and temporally, spatially, and species-resolved emissions for a typical weekday, Saturday, and Sunday in each season (Versions 5.2 and 5.3). Version 5.2 contains total hydrocarbons (THC) speciated into 28 photochemical reactivity classes, while THC in Version 5.3 are speciated into 10 classes based on carbon bond IV chemistry.

22726 **(PB—88-137419/XAB) Development of the 1980 NAPAP (National Acid Precipitation Assessment Program) Emissions Inventory: area sources - Fall Saturday, Product DD (Version 5.3). Data file.** Mobley, J.D.; Zelmanowitz, S. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). 1980. mag tap. (EPA—600/7-86/057DD). NTIS CP T05.

See also PB—87-182879; Source tape is in the EBCDIC character set. This restricts preparation to 9 track, one-half inch tape only. Identify recording mode by specifying density only. For price at 6250 bpi density, call NTIS Computer Products. Price includes documentation, PB—88-132121.

The 1980 NAPAP Emissions Inventory 5.2 area source emissions data for the 48 contiguous United States and Canada (from 50 degrees to 125 degrees W. Longitude and from 25 degrees to 60 degrees N. Latitude) are contained in the data file. Temporally, spatially, and species-resolved emissions of 11 pollutants (SO_2, SO_4, NOx, Pb, CO, HCl, HF, NH_3, TSP, VOC, and total hydrocarbons) for a typical spring weekday for 88 source categories from 3070 U.S. counties and 150 source categories from 10 Canadian provinces are present. The data file (Product DD) is one of a series of 1980 NAPAP Emissions Inventory products. A report (Development of the 1980 NAPAP Emissions Inventory) documenting the contents of the data file is available as Product A. Other emissions inventory products include data files containing U.S. and Canadian annual point and area source emissions (Version 5.0) and temporally, spatially, and species-resolved emissions for a typical weekday, Saturday, and Sunday in each season (Versions 5.2 and 5.3). Version 5.2 contains total hydrocarbons (THC) speciated into 28 photochemical reactivity classes, while THC in Version 5.3 are speciated into 10 classes based on carbon bond IV chemistry.

22727 **(PB—88-137427/XAB) Development of the 1980 NAPAP (National Acid Precipitation Assessment Program) Emissions Inventory: area sources-Fall Sunday, Product EE (Version 5.3). Data file.** Mobley, J.D.; Zelmanowitz, S. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). 1980. mag tap. (EPA—600/7-86/057EE). NTIS CP T05.

See also PB—87-182879; Source tape is in the EBCDIC character set. This restricts preparation to 9 track, one-half inch tape only. Identify recording mode by specifying density only. For price at 6250 bpi density, call NTIS Computer Products. Price includes documentation, PB—88-132121.

The 1980 NAPAP Emissions Inventory 5.2 area source emissions data for the 48 contiguous United States and Canada (from 50 degrees to 125 degrees W. Longitude and from 25 degrees to 60 degrees N. Latitude) are contained in the data file. Temporally, spatially, and species-resolved emissions of 11 pollutants (SO_2, SO_4, NOx, Pb, CO, HCl, HF, NH_3, TSP, VOC, and total hydrocarbons) for a typical spring weekday for 88 source categories from 3070 U.S. counties and 150 source categories from 10 Canadian provinces are present. The data file (Product EE) is one of a series of

1980 NAPAP Emissions Inventory products. A report (Development of the 1980 NAPAP Emissions Inventory) documenting the contents of the data file is available as Product A. Other emissions inventory products include data files containing U.S. and Canadian annual point and area source emissions (Version 5.0) and temporally, spatially, and species-resolved emissions for a typical weekday, Saturday, and Sunday in each season (Versions 5.2 and 5.3). Version 5.2 contains total hydrocarbons (THC) speciated into 28 photochemical reactivity classes, while THC in Version 5.3 are speciated into 10 classes based on carbon bond IV chemistry.

22728 **(PB—88-137484/XAB) Natural sulfur flux from the Gulf of Mexico: dimethyl sulfide, carbonyl sulfide, and sulfur dioxide. Technical report.** Van Valin, C.C.; Luria, M.; Wellman, D.L.; Gunter, R.L.; Pueschel, R.F. (National Oceanic and Atmospheric Administration, Boulder, CO (USA). Air Resources Lab.). Jun 1987. 20p. (NOAA-TR-ERL—432). NTIS, PC A03/MF A01.

Atmospheric measurements of natural sulfur compounds were performed over the northern Gulf of Mexico during the late summer months of 1984. Air samples were collected with an instrumented aircraft at elevations of 30-3500 m, during both day and night. Most air samples were representative of the clean maritime atmosphere, although some were from continental contaminated air during periods of offshore flow at the coastline. In all samples, carbonyl sulfide concentrations were within the range of 400-500 pptv. Conversely, the dimethyl sulfide concentrations showed significant variability: during clean atmospheric conditions the average of all measurements was 27 pptv, whereas under polluted conditions the average was 7 pptv. Measureable quantities of dimethyl sulfide (>5 pptv) were not observed above the boundary layer. The average sulfur dioxide concentration measured in the marine (clean) atmosphere was 215 pptv, which is consistent with the oxidation of dimethyl sulfide being its major source.

22729 **(PB—88-138045/XAB) National Acid Precipitation Assessment Program annual report 1985 to the President and congress.** Herrick, C.N. (National Acid Precipitation Assessment Program, Washington, DC (USA)). 1985. 113p. (NAPAP—85/04). NTIS, PC A06/MF A01.

See also report for 1982, PB—83-215624 and report for 1986, PB—88-138037.

This report covers the research activities of the National Acid Precipitation Assessment Program (NAPAP) in FY 1985. Individual chapters cover NAPAP research in the topical areas of Natural Sources, Man-made sources, Atmospheric Processes, Deposition Monitoring, Aquatic Effects, Terrestrial Effects, Effects on Materials and Cultural Resources, Control Technologies, and International Activities. It also includes a list of all FY 1985 NAPAP-sponsored publications.

22730 **(PB—88-139837/XAB) Aircraft observations of extreme ozone concentrations near thunderstorms.** Clarke, J.F.; Griffing, G.W. (Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab.). 1985. 8p. (EPA—600/J-85/504). NTIS, PC A02/MF A01.

Pub. in Atmospheric Environment, Vol. 19, No. 7, 1175-1179(Jul 1985).

Anomalously large short-term ozone concentrations were observed on several occasions by aircraft during an experiment on August 5, 1980, to characterize the physical and chemical properties of the Baltimore urban plume. The ozone spikes of about 500 ppb were traversed by aircraft in less than 30 s (travel distance of less than 2 km). Analysis of these and ancillary data suggest that the ozone spikes may have resulted from ozone production by chemical reactions activated by lightning associated with thunderstorms.

22731 **(PB—88-139886/XAB) Proposed pragmatic methods for estimating plume rise and plume penetration through atmospheric layers.** Turner, D.B. (Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab.). 1985. 7p. (EPA—600/J-85/505). NTIS, PC A02/MF A01.

Pub. in Atmospheric Environment, Vol. 19, No. 7, 1215-1218(Jul 1985).

Methods are proposed for estimating plume rise taking advantage of data on the vertical variation of wind speed and temperature. In addition, partial penetration of the plume into the stable layer above the mixing height is considered.

22732 **(PB—88-139936/XAB) Evaluation of the effectiveness of chemical dust suppressants on unpaved roads. Report for June 1984-November 1986.** Muleski, G.E.; Cowherd, C. (Midwest Research Inst., Kansas City, MO (USA)). Nov 1987. 93p. NTIS, PC A05/MF A01.

The report gives results of measurements of the long-term effectiveness of five unpaved-road chemical dust suppressants. Effectiveness at controlling total particulate emissions in three size fractions was determined over several cycles of chemical application, control effectiveness decay, and chemical reapplication. The chemicals were applied in quantities that spanned the range of common practice in the steel industry. Traffic parameters were typical of the steel industry. Over a 30-day period, control effectiveness of each chemical decreased: in some cases by as much as 50%, and in others by as little as 10%. Control effectiveness for all chemicals was greater than 95% immediately after chemical application or reapplication.

22733 **(PB—88-139969/XAB) Evaluating the toxicity of urban patterns of oxidant gases. 2. Effects in mice from chronic exposure to nitrogen dioxide.** Miller, F.J.; Graham, J.A.; Raub, J.A.; Illing, J.W.; Menache, M.G. (Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab.). 1987. 16p. (EPA—600/J-87/097). NTIS, PC A03/MF A01.

Pub. in Jnl. of Toxicology and Environmental Health, Vol. 21, 99-112(1987).

This study evaluates the influence of a chronic exposure to an urban pattern of NO_2 (continuous baseline exposure of 0.2 ppm on which were superimposed two 1-hr spikes of 0.8 ppm NO_2, 5 days/wk) as compared to the baseline exposure to determine the contribution of the spikes to toxicity. Mice were exposed for up to 52 wk with interim examinations. Multivariate analysis of variance revealed a statistically significant treatment effect on infectivity ($p=0.05$) and pulmonary function ($p=0.03$) parameters. Infectivity mortality of mice in the spiked exposure regimen was significantly greater than that in either the NO_2-background exposed mice or in control mice. Four of the pulmonary-function variables exhibited the greatest differences among the treatment groups: end expiratory volume, vital capacity, respiratory system compliance, and multiple-breath nitrogen washout. Results from the pulmonary function analyses indicate that the spiked exposures to 0.8 ppm NO_2 may have induced a subtle lesion. The chronic study results indicate that the presence of spikes of NO_2 is contributing significantly to effects on antibacterial lung defenses and pulmonary function of mice.

22734 **(PB—88-140272/XAB) Development of collection methods for semivolatile organic compounds in ambient air. Final report, July 1984-December 1986.** Bidleman, T.F.; Zaranski, M.T.; Patton, G.W. (South Carolina Univ., Columbia (USA). Dept. of Chemistry). Dec 1987. 175p. NTIS, PC A08/MF A01.

Cartridges containing solid adsorbents between layers of polyurethane foam (PUF) were evaluated for collecting chlorobenzenes, chlorophenols, hexachlorocyclohexanes (HCHs), and two-ring aromatic hydrocarbons. The 26-sq.cm cross-section glass cartridges, packed with Tenax (5-10 g), XAD-2 (14-16 g), or Florisil (30 g) between two 2.5-cm thick PUF slices, were designed to fit into the head of a General Metal Works PS-1 sampler. An inlet was built to vaporize test compounds into a clean airstream and sweep them into the adsorbent traps. Collection-efficiency experiments at 20° C were conducted by injecting test compounds into the sampling train and determining by mass balance the percentages recovered from the traps. Retention volumes and theoretical plate numbers were determined for dichlorobenzene elution bands on PUF-Tenax cartridges. Dichlorobenzenes and two-ring aromatic hydrocarbons were collected from up to 165 cu. m air on PUF-Tenax (10 g Tenax), with mass balances averaging 88%. At 285-372 cu. m air, mass balances for tetra- through hexachlorobenzenes and HCHs averaged 89% on PUF-Tenax (5 g Tenax), 80% on PUF-XAD-2, and 78% on PUF-Florisil. Di- and trichlorophenols were collected

without breakthrough by PUF-Tenax, but low recoveries were observed for pentachlorophenol and 2,3,4,5-tetrachlorophenol. Recoveries of chlorophenols were poorer from PUF-Florisil than from PUF-Tenax or PUF-XAD-2.

22735 **(PB—88-140454/XAB) Alpha-dicarbonyl yields from the NOx-air photooxidations of a series of aromatic hydrocarbons in air.** Tuazon, E.C.; Mac Leod, H.; Atkinson, R.; Carter, W.P.L. (California Univ., Riverside (USA). Statewide Air Pollution Research Center). 1986. 6p. NTIS, PC A02/MF A01.

Pub. in Environmental Science and Technology, Vol. 20, No. 4, 383-387(Apr 1986.

The yields of the ring-cleavage products glyoxal, methylglyoxal and biacetyl from the reactions of OH radicals with benzene, toluene, o-, m- and p-xylene and 1,2,3-, 1,2,4- and 1,3,5-trimethylbenzene in the presence of part-per-million concentrations of NO have been determined in one atmosphere of air using in-situ long pathlength Fourier-transform infrared absorption spectroscopy and differential optical absorption spectroscopy with supplementary gas-chromatographic analyses. The yields of glyoxal and methylglyoxal were respectively: from toluene, 0.105 plus or minus 0.019 and 0.146 plus or minus 0.006; from o-xylene, 0.087 plus or minus 0.012 and 0.246 plus or minus 0.020; from m-xylene, 0.086 plus or minus 0.011 and 0.319 plus or minus 0.009; from p-xylene, 0.225 plus or minus 0.039 and 0.105 plus or minus 0.034; from 1,2,3-trimethylbenzene, 0.058 plus or minus 0.008 and 0.152 plus or minus 0.025; and from 1,2,4-trimethylbenzene, 0.048 plus or minus 0.005 and 0.357 plus or minus 0.017.

22736 **(PB—88-140470/XAB) Size distributions of species in fine particles in Denver using a micro-orifice impactor.** Hasan, H.; Dzubay, T.G. (Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab.). 1987. 14p. (EPA—600/J-87/108). NTIS, PC A03/MF A01.

Pub. in Aerosol Science and Technology, Vol. 6, 29-39(Feb 1987).

Size-fractionated fine particles in Denver, Colorado, were collected by a micro-orifice impactor and analyzed for mass and elemental composition by a beta-gauge and an x-ray fluorescence spectrometer. A least-squares procedure was used to fit a log-normal distribution function to the data in order to determine values and uncertainties for the mass median diameter and geometric standard deviation. The validity of the uncertainties so determined was tested by comparing them to uncertainties derived from Monte Carlo simulations.

22737 **(PB—88-140553/XAB) Catalytic treatment of air-stripping effluents.** Kosusko, M.; Mullins, M.E.; Rogers, T.N.; Ramanathan, K. (Research Triangle Inst., Research Triangle Park, NC (USA)). Dec 1987. 20p. NTIS, PC A03/MF A01.

The paper reviews the applicability of catalytic oxidation to control ground-water air-stripping gaseous effluents with emphasis on system designs and case histories. The contaminants and catalyst poisons encountered in stripping operations are also reviewed. Vapor-phase carbon adsorption and thermal incineration, the treatment methods that have been applied most often, have some disadvantages: adsorption merely transfers the contaminant to a solid phase, which in turn requires disposal or regeneration; and thermal incineration may be expensive, since it requires a substantial energy input to destroy dilute gas-phase contaminants. A new alternative is appearing in the form of catalytic oxidation. Like thermal incineration, it is an ultimate disposal method, but the energy costs are lower.

22738 **(PB—88-143318/XAB) Mathematical modeling of the formation and dynamics of acidic aerosols. Final report.** Pilinis, C.; Seinfeld, J.H. (California Inst. of Tech., Pasadena (USA). Environmental Quality Lab.). 28 Oct 1987. 117p. NTIS, PC A06/MF A01.

The major objective of this study was the development of a state-of-the-science particulate acidic-aerosol model. The specific objectives were: Development of a model for predicting the size distribution and chemical composition of atmospheric aerosols containing sulfate, nitrate, ammonium, water, sodium, chloride and organic species from gas-phase concentrations and readily available atmospheric properties (temperature, relative humidity); and implementation of the model in a Lagrangian trajectory framework and evaluation on the model for selected days in predicting the size and composition distribution of aerosol in the SoCAB. Two aerosol systems were modeled: (a) sulfate/nitrate/ammonium system, and (b) ammonium/chloride/nitrate/sodium/sulfate/water system. The model was used to simulate the aerosol size and chemical composition for a trajectory from Anaheim to Rubidoux in the SoCAB, for which measured particulate concentrations were available. Comparisons between the observed and predicted aerosol concentrations showed that the model adequately predicted the concentrations of the major particulate compounds along the trajectory.

22739 **(PB—88-143391/XAB) Acid Deposition Research Program. Volume 1. Overview of the emission data: emission inventory of sulfur oxides and nitrogen oxides in Alberta.** Picard, D.J.; Colley, D.G.; Boyd, D.H. (Acid Deposition Research Program, Calgary (Alberta)). Nov 1987. 97p. (ADRP-A—1-87). NTIS, PC E04/MF A01.

Also pub. as Acid Deposition Research Program, Calgary (Alberta) rept. no. ADRP-B-12-87. See also PB—88-143532, and PB—88-143409.

To predict air quality properly at a given location, it is necessary to identify all emission sources that will have significant impact at that location. Furthermore, the atmospheric pollutants that are emitted by these sources must be identified and quantitatively characterized. Once the air-quality predictions have been made, it is desirable to have some historical air-quality data for comparison. An efficient means of obtaining this information is through the use of detailed emission inventories and an inventory of air-quality-monitoring stations. Therefore, as part of the Alberta Government/Industry Acid-Deposition Research Program (ADRP), three comprehensive inventories have been developed, namely: a sulfur dioxide (SO_2) emission inventory, a nitrogen oxides (NOx) emission inventory, and an inventory of air quality-monitoring stations. Documentation of the developed inventories is presented in four volumes. Volume 1, Overview of the Emission Data, comprises a brief summary describing development of the inventory, a summary of emissions data by emission type, geographic region, industrial category and ecoregion, a comparison with results of previous inventories, and a summary of the air-quality-monitoring station inventory. Conclusions and recommendations are also presented in the volume. Detailed summary tables describing emissions by major-source category, petroleum-industry-facility type, and source type for each geographic emission region are appended to the volume.

22740 **(PB—88-143409/XAB) Acid-deposition research program. Volume 2. Design of the emission inventory: emission inventory of sulfur oxides and nitrogen oxides in Alberta.** Picard, D.J.; Colley, D.G.; Boyd, D.H. (Acid Deposition Research Program, Calgary (Alberta)). Nov 1987. 100p. (ADRP-A—2-87). NTIS, PC E04/MF A01.

Also pub. as Acid Deposition Research Program, Calgary (Alberta) rept. no. ADRP-B-13-87. See also PB—88-143391, and PB—88-143417.

To predict air quality properly at a given location, it is necessary to identify all emission sources that will have significant impact at that location. Furthermore, the atmospheric pollutants that are emitted by these sources must be identified and quantitatively characterized. Once the air-quality predictions have been made, it is desirable to have some historical air-quality data for comparison. An efficient means of obtaining this information is through the use of detailed emission inventories and an inventory of air-quality-monitoring stations. Therefore, as part of the Alberta Government/Industry Acid Deposition Research Program (ADRP), three comprehensive inventories have been developed, namely: a sulfur dioxide (SO_2) emission inventory, a nitrogen oxides (NOx) emission inventory, and an inventory of air-quality-monitoring stations. Volume 2, Design of the Emission Inventory, presents detailed information on the classification systems, source characterization, emission calculations, and data fields employed for each emission type. Details describing the source-sampling program conducted as part of the NOx inventory and the computerization of the

inventories are also presented in this volume. Furthermore, a detailed discussion of some of the major air-quality-monitoring networks in Alberta is included.

22741 (PB—88-143417/XAB) Acid-deposition research program. Volume 3. Emission data base: emission inventory of sulfur oxides and nitrogen oxides in Alberta. Picard, D.J.; Colley, D.G.; Boyd, D.H. (Acid Deposition Research Program, Calgary (Alberta)). Nov 1987. 351p. (ADRP-A—3-87). NTIS, PC E13/MF A01.

Also pub. as Acid Deposition Research Program, Calgary (Alberta) rept. no. ADRP-B-14-87. See also PB—88-143409, and PB—88-143425.

As part of the Alberta Government/Industry, Acid Deposition Research Program (ADRP), three comprehensive inventories have been developed, namely: sulfur dioxide (SO_2) emission inventory (industrial sources), a nitrogen oxides (NOx) emission inventory (industrial, urban and highway sources), and an inventory of air-quality-monitoring stations (both industry and government operated stations). The three inventories are intended to serve as a source of information that will assist investigators in estimating the average rates of NOx and SO_2 emission in Alberta, and the geographic distribution of these emissions. The inventories will also be useful in the forecasting of future emissions. In this volume, a complete listing of each of the inventories is presented.

22742 (PB—88-143425/XAB) Acid-deposition research program. Volume 4. Results of the emission source surveys: emission inventory of sulfur oxides and nitrogen oxides in Alberta. Picard, D.J.; Colley, D.G.; Boyd, D.H. (Acid Deposition Research Program, Calgary (Alberta)). Nov 1987. 224p. (ADRP-A—4-87). NTIS, PC E08/MF A01.

Also pub. as Acid Deposition Research Program, Calgary (Alberta) rept. no. ADRP-B-15-87. See also PB—88-143417.

To predict air quality properly at a given location, it is necessary to identify all emission sources that will have significant impact at that location. Furthermore, the atmospheric pollutants that are emitted by these sources must be identified and quantitatively characterized. Once the air-quality predictions have been made, it is desirable to have some historical air quality data for comparison. An efficient means of obtaining the information is through the use of detailed emission inventories and an inventory of air-quality-monitoring stations. Therefore, as part of the Alberta Government/Industry Acid Deposition Research Program (ADRP), three comprehensive inventories have been developed, namely: a sulfur dioxide (SO_2) emission inventory, a nitrogen oxides (NOx) emission inventory, and an inventory of air quality monitoring stations. Volume 4, Results of the Emission Source Surveys, presents detailed results of the surveys conducted as part of the emissions inventory.

22743 (PB—88-143458/XAB) Acid-deposition research program. Volume 3. Environmental sulfur isotope studies in Alberta: a review. Krouse, H.R. (Acid Deposition Research Program, Calgary (Alberta)). Feb 1987. 105p. (ADRP-B—03-87). NTIS, PC E05/MF A01.

See also PB—88-143441, and PB—88-143466.

Contents include: principles of stable isotope research; sulfur-isotope abundance variations in nature; oxygen-isotope abundances in sulfates in relation to the sulfur cycle; sulfur-isotope composition of environmental receptors; conceptual modeling of sulfur-isotope abundances in the environment surrounding sour-gas-plant operations.

22744 (PB—88-143516/XAB) Acid-deposition research program. Volume 9. Effects of acid deposition on forests. Mayo, J.M. (Acid Deposition Research Program, Calgary (Alberta)). Feb 1987. 84p. (ADRP-B—09-87). NTIS, PC E04/MF A01.

See also PB—88-143508, and PB—88-143524.

The purpose of this paper is to review the recent literature concerned with acid deposition effects upon forests. The world-wide literature is reviewed and its relevance to the Alberta situation discussed. The discussion is confined to current material (late 1970's to present), using the older literature as necessary to complete the information in selected subject areas. The effects of ozone on forests are included even though ozone is not an acid former. This was done because recent articles have suggested that it may be involved with the problems in European forests, either as the primary pollutant or as a contributing factor.

22745 (PB—88-143524/XAB) Acid-deposition research program. Volume 10. An analysis of numerical models of air pollutant exposure and vegetation response. Krupa, S.V.; Kickert, R.N. (Acid Deposition Research Program, Calgary (Alberta)). Feb 1987. 120p. (ADRP-B—10-87). NTIS, PC E05/MF A01.

See also PB—88-143516, and PB—88-143532.

The ability to understand and predict temporal and spatial patterns of air-pollutant effects on vegetation continues to constitute an important need in agricultural and natural resource management. Thus, in the report the authors describe and evaluate the state of published mathematical models of air quality and vegetation response. The authors also identify the limitations in these models and describe some basic biological and statistical concepts of plant-response processes useful in experimental design toward a new and progressive approach to the problem analysis.

22746 (PB—88-143532/XAB) Acid-deposition research program. Volume 11. Acidic deposition and the environment: a literature overview. Legge, A.H.; Crowther, R.A. (Acid Deposition Research Program, Calgary (Alberta)). Nov 1987. 250p. (ADRP-B—11-87). NTIS, PC E09/MF A01.

See also PB—88-143524, and PB—88-143391.

Contents include: introduction to atmospheric chemistry and acidic-deposition processes; effects of acidic deposition on forests; acidic-deposition effects on agriculture; numerical models of air-pollutant exposure and vegetation response; effects of acidic deposition on soils; effects of acidic deposition on soil microorganisms and microbially mediated processes; effect of acidic deposition on geology and hydrogeology; effects of acidic deposition on surface-water acidification; acidic deposition in the Alberta context.

22747 (PB—88-145313/XAB) Computer architecture for research in meteorology and atmospheric chemistry. Final report. McHugh, J.; Pierce, J.; Rich, D.; Dunham, J.; McLin, D. (Microelectronics Center of North Carolina, Research Triangle Park (USA)). Dec 1987. 138p. NTIS, PC A07/MF A01.

The study examines the feasibility of constructing a peripheral hardware module that could be attached to a mini- or mid-sized computer to accelerate the execution of large air pollution models, such as the EPA's Regional Oxidant Model (ROM). Crucial information necessary to design such an accelerator is acquired by running the ROM computer code under instrumentation which shows how the computational load is distributed within the model and the data-transfer rates between each step of the model execution. These data reveal that a model such as the ROM is not amenable to acceleration using a vector-type architecture because the computational burden is too inhomogeneous in space and time. Simulations show that an accelerator based on the tile machine architecture would be capable of executing the ROM up to 100 times faster than the host machine working alone.

22748 (PB—88-145941/XAB) Air-quality monitoring at Sullom Voe using lichens as biological indicator species: results of the 1986 repeat photographic survey. James, P.W.; Syratt, W.J. (Shetland Oil Terminal Environmental Advisory Group, Aberdeen (UK)). 1987. 24p. NTIS, PC E04/MF E04.

See also PB—84-205368.

The 1986 survey was carried out between July 7th and 11th. The weather was satisfactory for photographic work, though rain did cause minor delays. A good set of transparencies was obtained. The 22 monitoring sites are described in detail. The minor modifications to site 4 and 14 are described in the 1981/1982 report and the replacement site 17R is described in the Appendix to the same report. All but one of the sites were relocated successfully and all marks were found to be in excellent condition. It was considered unnecessary to remark any of the sites. Recently, (1985-1986), site 21, an old crofthouse wall, had been demolished and the stones used for rebuilding. There was no suitable alternative nearby, and the decision was taken to abandon site 21 for monitoring purposes.

22749 **(PB—88-146865/XAB) Japanese activities in SO_2 and NOx control. Report for April 1986-March 1987.** Sedman, C.B.; Ando, J. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). Dec 1987. 19p. (EPA—600/D-87/369). NTIS, PC A03/MF A01.

The paper reviews Japanese activities in SO_2 and NOx control. From 1970 to 1985, energy use in Japan increased by 25%, and annual coal consumption rose from virtually nothing to 20 million tons, yet emissions of SO_2 declined by 75% and NOx by 40%. While increases in hydroelectric and nuclear energy sources and use of lower sulfur fuel oil have contributed to the emissions reduction, the most prominent technological achievements have occurred in the successful implementation of SO_2 and NOx controls. Since 1968, nearly 1600 flue-gas-desulfurization (FGD) systems and 250 selective catalytic reduction (SCR) units have been constructed. Recent and current activities include simplified FGD operations, SCR experience in coal-fired systems, and transfer of control technology to waste-to-energy plants.

22750 **(PB—88-147814/XAB) Significances of the variability of airway paths and their air-flow rates to dosimetry model predictions of the absorption of gases.** Overton, J.H.; Barnett, A.E.; Graham, R.C. (Northrop Services, Inc., Research Triangle Park, NC (USA)). Dec 1987. 34p. (EPA—600/D-87/364). NTIS, PC A03/MF A01.

The ozone-dosimetry model developed at EPA was developed to be used in conjunction with species lung models that summarize the structure of a lung as a lung of many equivalent paths. The paper reports the results of a preliminary study into the question of whether or not more realistic lung structures and airflow rates in individual airways need to be taken into account in order to make more-accurate predictions of ozone uptake. The results indicate that in order to obtain a better understanding of the distribution of absorbed ozone in the lower respiratory tract (LRT), realistic lung structures need to be taken into account. Whereas, estimating LRT dose using a lung model composed of equivalent paths was found to give the same results obtained as when the complex lung structure was taken into account. The information will allow for a better use of experimental uptake data for the evaluation of dosimetry model predictions as well as for improved interpreting of toxicological data.

22751 **(PB—88-147905/XAB) Sublethal biological-effects monitoring in the region of Sullom Voe Shetland, July 1986.** Widdows, J.; Dixon, D.; Donkin, P.; Evans, S.V.; Lowe, D. (Institute for Marine Environmental Research, Plymouth (UK)). 1987. 35p. NTIS, PC E05/MF E05.

See also report dated 1982, PB—84-203249.

The overall objective of the field program is to use the common mussel Mytilus edulis, as a sentinel organism to monitor the sublethal biological effects of oil pollution in the littoral environment in the vicinity of the oil terminal at Sullom Voe, in order to detect any effects of industrial activity in the area. Combined chemical and biological effects measurements provide a means of quantifying the extent and degree of oil contamination and the resultant impact on physiological and cellular performance.

22752 **(PB—88-148556/XAB) Urban air-toxics monitoring program.** (Engineering-Science, Inc., Cary, NC (USA)). Sep 1987. 20p. NTIS, PC A03/MF A01.

Supersedes PB—88-113386.

To assist States and local agencies, EPA has developed a program to address the status of the air-toxics problem in their localities. The document provides a description of (1) the program, (2) support EPA will provide to participating agencies and (3) the responsibilities of State and local agencies.

22753 **(PB—88-149059/XAB) Locating and estimating air emissions from sources of polycyclic organic matter (POM).** (Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards). Sep 1987. 400p. (EPA—450/4-84/007P). NTIS, PC A17/MF A01.

To assist groups interested in inventorying air emissions of various potentially toxic substances, EPA is preparing a series of documents such as this to compile available information on sources and emissions of these substances. This document deals specifically with polycyclical organic matter (POM). Its intended audience includes Federal, State, and local air pollution personnel and others interested in locating potential emitters of POM and in making gross estimates of air emissions therefrom. Information is presented on (1) the types of sources that may emit POM, (2) process variations and release points that may be expected within these sources, and (3) available emissions information indicating the potential for POM release into the air from each operation.

22754 **(PB—88-149224/XAB) Health-hazard evaluation report HETA 85-415-1806, Eccles Saw and Tool Company, Cincinnati, Ohio.** Hunninen, K.; Rondinelli, R. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Jul 1987. 23p. (HETA—85-415-1806). NTIS, PC A03/MF A01.

In response to an employee request, an evaluation was made of metal-dust exposures from the process of sharpening saw blades and tools at the Eccles Saw and Tool Company, Cincinnati, Ohio. In two personal air samples, the following concentrations were determined: cobalt, 26 and 63 micrograms/cubic meter (microg/m^3); tungsten, 365 and 925 microg/m^3; nickel, 3.9 and 9.3 microg/m^3; cadmium, less than 2 microg/m^3; and silver, less than 2 microg/m^3. Air containing cobalt at 30 microg/m^3 and nickel at 7 microg/m^3 was being discharged back into the workspace from the recirculated local-exhaust ventilation air. A medical evaluation was performed on three workers; all three reported coughing four to six times a day, four or more days per week, with occasional episodes of wheezing. Two of these employees were grinders, having been working at the company for 15 and 85 months, while the other was a truck driver, who spent about 3 hours per day in the shop, but did no grinding.

22755 **(PB—88-149257/XAB) Health-hazard evaluation report HETA 85-540-1816, International Association of Fire Fighters, Washington, DC.** Burr, G.A. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Jul 1987. 17p. (HETA—85-540-1816). NTIS, PC A03/MF A01.

In response to a request from the International Association of Fire Fighters, the toxicity of the commercially available chimney-fire extinguishing product Chimfex was evaluated. In a simulated worse case situation (minimal ventilation and no containment of the extinguisher), area air sampling was performed. Substances detected in the air samples included zinc, zinc-oxide, sulfur-dioxide barium-oxide, and cadmium-oxide. Sulfur-dioxide concentrations ranged from 0.39 to 0.63mg/cu m, and cadmium-oxide concentrations ranged from 0.01 to 0.02mg/cu m. The presence of cadmium was not expected. Zinc oxide fumes ranged from 6.4 to 48mg/cu m which exceeded the NIOSH recommended ceiling limit of 15mg/cu m for 15 minutes. The author concludes that a potential health hazard may exist from exposure to zinc oxide fumes among users of Chimfex if used in poorly ventilated or confined spaces. The author recommends that a statement regarding the principal decomposition products and their health effects be placed on the product, both the container and the extinguisher itself.

22756 **(PB—88-149265/XAB) Evaluation of H_2S continuous monitors using metal-oxide semiconductor sensors.** Smith, J.P.; Shulman, S.A. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). 1987. 49p. NTIS, PC A03/MF A01.

A determination was made of the usefulness of five different commercial monitors to detect hydrogen sulfide. These devices used metal-oxide remote semiconductor sensors wired to a controller. On some models, the sensors can be located at distances up to a mile from the controller.

22757 **(PB—88-150958/XAB) Guideline on air-quality models (revised). Supplement A.** (Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards). Jul 1987. 35p. (EPA—450/2-78/027R-SUPPL-A). NTIS, PC A03/MF A01.

See also PB—86-245248.

This guideline recommends air quality modeling techniques that may be applied to air-pollution-control strategy evaluations and new source reviews, including prevention of significant deterioration. It is intended for use by EPA Regional Offices in judging the adequacy of modeling analyses performed by EPA, by State and local agencies, and by industry and its consultants. It also identifies modeling techniques and data bases that EPA considers acceptable. The guideline makes specific recommendations concerning air-quality models, data bases, and general requirements for concentration estimates. This is Supplement A to the guideline. It contains: (1) addition of a specific version of the Rough Terrain Diffusion Model (RTDM) as a screening model; (2) modification of the downwash algorithm in the Industrial Source Complex (ISC) model; (3) addition of the Offshore and Coastal Dispersion (OCD) model to Appendix A; and, (4) addition of the AVACTA II model to Appendix B.

22758 **(PB—88-160379/XAB) Control technology overview report: CFC (chlorofluorocarbon) emissions from rigid foam manufacturing. Final report, March-November 1986.** Wert, K.P.; Nelson, T.P.; Quass, J.D. (Radian Corp., Austin, TX (USA)). Jan 1988. 199p. NTIS, PC A09/MF A01.

See also PB—88-160387.

The report estimates total chlorofluorocarbon (CFC) emissions from the various rigid foam manufacturing processes and from the foam products themselves, and examines potential methods for reducing these emissions. Options studied include replacement of CFC-blown products with alternative products not requiring CFCs, replacement of ozone-depleting CFCs with other chemicals less likely to destroy stratospheric ozone, and recovery/recycle of CFCs released during manufacturing processes. In the production of rigid cellular foams, CFCs are used as physical blowing agents to reduce foam density and impart thermal insulating properties. Such rigid foams include polyurethane, polystyrene, polyethylene, polypropylene, polyvinyl chloride, and phenolic foams. Uses of these foams include building insulation, packaging materials, and single-service dinnerware. Depletion of stratospheric ozone through action of halocarbons, particularly CFCs, has been the subject of extensive study and wide debate. Although many uncertainties remain, current scientific evidence strongly suggests that anthropogenic CFCs could contribute to depletion of the stratospheric ozone layer as was first postulated in 1974.

22759 **(PB—88-160387/XAB) Control technology overview report: CFC-11 emissions from flexible polyurethane foam manufacturing. Final report, March-October 1986.** Farmer, R.W.; Nelson, T.P. (Radian Corp., Austin, TX (USA)). Jan 1988. 216p. NTIS, PC A10/MF A01.

See also PB—88-160379.

The report gives results of an engineering evaluation of technical options to reduce chlorofluorocarbon (CFC) emissions from flexible slabstock and molded polyurethane foam manufacturing plants. Among the technical options studied were recovery and recycle of CFC-11, alternative chemicals and processes, and substitute products. Two possible emission control methods were studied in detail: substitution of methylene chloride as the auxiliary foam blowing agent and carbon adsorption/recycle of exhausted CFC-11 vapors. Promising near-term control options identified for slabstock production were methylene chloride substitution for CFC-11, and establishment of a minimum foam density to reduce the amount of auxiliary blowing agent used. For molded polyurethane foam production, use of chemical systems which eliminate the need for auxiliary blowing agents appeared to be a near-term option. Possible longer-term options included carbon adsorption with CFC-11 recovery, development of chemical systems requiring little or no auxiliary blowing agents for slabstock production, and commercialization of new alternative blowing agents. Each longer-term option has in common a need for additional information to adequately define the optimal implementation strategy.

22760 **(PB—88-856729/XAB) Formaldehyde. June 1970-December 1987 (citations from the NTIS data base). Report for June 1970-December 1987.** (National Technical Information Service, Springfield, VA (USA)). Jan 1988. 182p. NTIS PC N01/MF N01.

Supersedes PB—87-852075.

This bibliography contains citations concerning the health hazards of formaldehyde inhalation. Health hazard evaluation reports of industrial sites are discussed and the effects of formaldehyde on animals and humans are considered. Industrial hygiene sampling method and analytical methods to quantitate formaldehyde are also discussed. (This updated bibliography contains 348 citations, 20 of which are new entries to the previous edition.)

22761 **(PNL-SA—15557) Ocean general circulation models: Report on proceedings of a meeting of ocean and climate modelers.** Sherwood, C.R.; Downing, J.P. (Pacific Northwest Lab., Richland, WA (USA)). Jan 1988. Contract AC06-76RL01830. 101p. (CONF-8707147—Summ.). NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88005530/JAW.

From Meeting on ocean and climate modelers: ocean general circulation models; Sequim, WA, USA (30 Jul 1987).

This report summarizes the proceedings of a meeting of ocean general circulation modelers and oceanographers sponsored by the US Department of Energy, Office of Energy Research, Carbon Dioxide Research Division and arranged by Pacific Northwest Laboratory. The presentations covered the following topics: new developments in coupling Ocean General Circulation Models and Atmosphere General Circulation Models, improvements on the representation of mixed-layer and sea ice processes, optimization of model codes for parallel processing on the next generation of supercomputers and advances in support software for statistical evaluation and display of model data, new model calculations of climate response to CO_2-induced radiative forcing, ocean data sets and their limitations, and key regional ocean processes for climate models. 77 refs., 43 figs., 8 tabs.

22762 **Subcellular localization of glycosidases and glycosyltransferases involved in the processing of N-linked oligosaccharides.** Sturm, A.; Johnson, K.D.; Szumilo, T.; Elbein, A.D.; Chrispeels, M.J. (Univ. of California, San Diego, La Jolla). *Plant Physiology;* **85**: No. 3, 741-745(Nov 1987).

Using isopycnic sucrose gradients, we have ascertained the subcellular location of several enzymes involved in the processing of the N-linked oligosaccharides of glycoproteins in developing cotyledons of the common bean, Phaseolus vulgaris. All are localized in the endoplasmic reticulum (ER) or Golgi complex as determined by co-sedimentation with the ER marker, NADH-cytochrome c reductase, or the Golgi marker, glucan synthase I. Glucosidase activity, which removes glucose residues from $Glc_3Man_9(GlcNAc)_2$, was found exclusively in the ER. All other processing enzymes, which act subsequent to the glucose trimming steps, are associates with Golgi. These include mannosidase I (removes 1-2 mannose residues from Man/sub 6-9/[$GlcNAc_2$), mannosidase II (removes mannose residues from $GlcNAcMan_5[GlcNAc_2$), and fucosyltransferase (transfers a fucose residue to the Asn-linked GlcNAc of appropriate glycans). The authors have previously reported the localization of two other glycan modifying enzymes (GlcNAc-transferase and xylosyltranferase activities) in the Golgi complex. Attempts at subfractionation of the Golgi fraction on shallow sucrose gradients yielded similar patterns of distribution for all the Golgi processing enzymes. Subfractionation on Percoll gradients resulted in two peaks of the Golgi marker enzyme inosine diphosphatase, whereas the glycan processing enzymes were all enriched in the peak of lower density. These results do not lend support to the hypothesis that N-linked oligosaccharide processing enzymes are associated with Golgi cisternae of different densities.

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REFER ALSO TO CITATION(S) 21613, 22583, 22586, 22587, 22589, 22621, 22667, 22669, 22812

22763 (DOE/ER/60493—1-Vol.2, pp 214-217) **Energy use/weatherization and indoor air quality: field study results.** Harper, J.P.; Dudney, C.S.; Hawthorne, A.R.; Spengler, J.D. (Tennessee Valley Authority, Chattanooga). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

In a recent indoor air quality field study involving over 300 residences, approximately half received an in-depth energy audit. These audits, conducted by trained utility energy advisors, provided an extensive characterization of the building's space conditioning equipment and systems and other factors related to the structure's energy use of weatherization. Comparisons are made between indoor radon levels and the basic house type, crawlspace design, design of the space conditioning system, and the degree of door and window weatherization.

22764 (DOE/ER/60493—1-Vol.2, pp 285-289) **Seeking strategy for high indoor radon concentrations.** Castren, O.; Voutilainen, A.; Maekelaeinen. (Finnish Centre for Radiation and Nuclear Safety, Helsinki). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

A seeking program is described whereby the work of local authorities can be optimized. Only those areas or groups of dwellings are measured in which the measurement cost per averted dose is lower than a certain value. Such groups and areas can be identified from survey experience and/or through an iterative trial and error process. In Finland, the program is expected to find more than 70 per cent of the dwellings exceeding 800 Bq/m^3, although less than 10 per cent of the total housing stock is measured. The use of results for classification of future building areas is also discussed.

22765 (DOE/ER/60493—1-Vol.2, pp 290-294) **Geological variation of radon sources and indoor radon along the southwestern edge of the Canadian shield.** Steck, D.J. (St. John's Univ., Collegeville, MN). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Radon source and indoor radon concentrations have been measured in over 250 homes located along the southwestern edge of the Canadian shield. Waterborne radon ranged from 400 to 3.6 x 10^5 Bq/m^3 and had an average value of 9900 Bq/m^3. Soilborne radon was sampled in four ways: in laboratory analysis, samples showed an average available radon emanation of 4 Bq/kg, and an average radon content of 34 Bq/kg while in situ the surface radon ranged from 10 to 100 Bq/kg and the soil gas averaged 5 kBq/m^3. Indoor airborne radon measured to date has ranged from 20 to 1100 Bq/m^3 and varied with season, year, compartment, and geology. A report of the full data set, as well as the correlation between indoor radon concentrations, source strengths, and local geological features, will be presented at the meeting.

22766 (DOE/ER/60493—1-Vol.2, pp 295-299) **Intensive study of radon and remedial measures in New Jersey homes: preliminary results.** Sextro, R.G.; Harrison, J.; Moed, B.A.; Revzan, K.L.; Turk, B.H.; Grimsrud, D.T.; Nero, A.V.; Sanchez, D.C.; Teichman, K.Y. (Lawrence Berkeley Lab., CA). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2). Contract AC03-76SF00098.

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

In order to examine the influence of environmental and building factors on radon entry into homes, an intensive investigation of radon source characterization, entry mechanisms, procedures for remediation diagnosis, and mitigation system performance evaluation is being conducted in occupied New Jersey, USA, homes. One home serves as a control and remains in the original state during the experiment. Radon mitigation systems are installed in the other six homes. Indoor radon levels, indoor and outdoor temperatures, windspeed and direction, pressure differentials, soil temperature and moisture are some of the parameters being monitored continuously. Periodic measurements of soil air permeability, soil gas radon concentrations, ventilation rates, and radon progeny are also being conducted. The homes will be monitored for a 12 month period and various mitigation systems cycled on and off on a weekly basis. The relation of the various parameters to radon entry is discussed and implications for radon mitigation diagnostics are presented.

22767 (DOE/ER/60493—1-Vol.2, pp 300-304) **Radon mitigation through residential pressurization control strategy.** Fortmann, R.C.; Nagda, N.L.; Harper, J.P. (GEOMET Technologies, Inc., Germantown, MD). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

A network of low-pressure differential transducers was installed in two research houses to measure pressure differences between outdoors and indoor zones. Measurements made during summer 1986 and winter 1986-1987 under naturally varying outdoor conditions and during operation of a subslab airspace purge system rarely exceeded 4 pascals (Pa). Changes in pressure differentials exhibited an inverse relationship with the indoor/outdoor temperature difference. Indoor radon concentrations varied inversely with pressure differences between the basement and outdoors under summertime conditions. This relationship was less evident under wintertime conditions with heavy snow cover. During both seasons, indoor radon concentrations were reduced substantially during operation of a low flow purge system.

22768 (DOE/ER/60493—1-Vol.2, pp 305-309) **Resolving the radon problem in Clinton, New Jersey, houses.** Osborne, M.C. (Environmental Protection Agency, Research Triangle Park, NC). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Significantly elevated radon concentrations were found in several adjacent houses in Clinton, New Jersey. The United States Environmental Protection Agency screened 56 of the houses and selected 10 for demonstration of radon reduction techniques. Each of the 10 houses received an intensive radon diagnostic evaluation before a house-specific radon reduction plan was developed. Before and after the plans were implemented, radon concentrations were determined by charcoal canisters and continuous radon monitors. A variety of sealing and sub-slab depressurization techniques were applied to the 10 houses. Radon concentrations were reduced by over 95% in all 10 houses. Five homeowners meetings were held to explain the radon reduction techniques being implemented and to answer questions of homeowners interested in applying similar radon reduction efforts to their houses.

22769 (DOE/ER/60493—1-Vol.2, pp 310-315) **Model for indoor radon variations.** Arvela, H.; Winqvist, K. (Finnish Centre for Radiation and Nuclear Safety, Helsinki). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The model relates radon concentration to variations in source strength and meteorological factors. The constant source represents radon diffused from building materials or from soil. The pressure-difference dependent source represents radon flowing with soil pore air and driven by the stack effect. In a house with a constant source the radon concentration decreases when the air exchange rate increases due to increasing temperature differences, whereas the flow source causes an increasing concentration. A pure pressure-difference dependent source gives a winter-summer ratio of 2-3.5. In houses with a constant source, the diurnal maximum occurs in the afternoon, while in houses with a pressure-difference dependent source the maximum is reached in the early morning.

22770 (DOE/ER/60493—1-Vol.2, pp 316-320) **Impacts of balanced and exhaust mechanical ventilation on indoor radon.** Fisk, W.J.; Mowris, R.J. (Lawrence Berkeley Lab., CA). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2). Contract AC03-76SF00098.

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Models for estimating radon entry rates, indoor radon concentrations, and ventilation rates in houses with a basement or a vented crawl-space and ventilated by natural infiltration, mechanical exhaust ventilation, or balanced mechanical ventilation are described. Simulations are performed for a range of soil and housing characteristics using hourly weather data for the heating season in Spokane, WA. For a house with a basement, we show that any ventilation technique should be acceptable when the soil permeability is less than approximately $10^{-13}m^2$. However, exhaust ventilation leads to substantially higher indoor radon concentrations than infiltration or balanced ventilation with the same average air exchange rate when the soil permeability is $10^{-12}m^2$ or greater. For houses with a crawl-space, indoor radon concentrations are lowest with balanced ventilation, intermediate with exhaust ventilation, and highest with infiltration.

22771 (DOE/ER/60493—1-Vol.2, pp 321-326) **Neutralization behavior of Po-218 in indoor air.** Hopke, P.K.; Chu, K.D. (Univ. of Illinois, Urbana). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

In addition to small ion recombination, two other mechanisms have been identified for the neutralization of the $^{218}Po^{+}$ ion formed by the decay of ^{222}Rn in indoor air. In the electron transfer mechanism, an oxidized polonium species with an ionization potential of the order of 10.4 eV can extract an electron from a gas of lower ionization potential such as NO_2. A second mechanism involves the presence of high electron affinity molecules such as NO_2 that retain electrons in the region around the Po ion recoil path and transport that electron to the polonium ion to be neutralized. A continuous flow system has been developed to measure the rates of these processes under carefully controlled conditions. The results of the measurements of these rate constants and their implications for the behavior of ^{218}Po in indoor air will be presented.

22772 (DOE/ER/60493—1-Vol.2, pp 329-334) **Statistical aspects of autoregressive models in the assessment of radon mitigation.** Dunn, J.E.; Henschel, D.B. (Univ. of Arkansas, Fayetteville). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Radon values, as reflected by hourly scintillation counts, seem dominated by major, pseudo-periodic, random fluctuations. This methodological paper reports a moderate degree of success in modeling these data using relatively simple autoregressive-moving average models in order to assess the effectiveness of radon mitigation techniques in existing housing. While accounting for the natural correlation of successive observations, familiar summary statistics such as steady state estimates, standard errors, confidence limits, and tests of hypothesis are produced. The Box-Jenkins approach is used throughout. In particular, intervention analysis provides an objective means of assessing the effectiveness of an active mitigation measure, such as a fan off/on cycle. Occasionally, failure to declare a significant intervention has suggested a diagnosis of the data collection procedure.

22773 (DOE/ER/60493—1-Vol.2, pp 335-339) **Indoor ion concentration.** Graeffe, G.; Keskinen, J.; Janka, K.; Lehtimaeki, M. (Tampere Univ. of Technology, Finland). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Radon, small airborne ion and aerosol particle concentrations have been measured continuously in Finnish dwellings and offices. As expected, radon is found to be the major source for small ion formation in indoor air. In clean air a equation between the concentrations of radon and small ions is found to be valid. In normal living conditions the ion concentration is affected also by variations in particle concentration caused by smoking, cooking etc.

22774 (DOE/ER/60493—1-Vol.2, pp 340-346) **Some results from the demonstration of indoor radon reduction measures in block basement houses.** Henschel, D.B.; Scott, A.G. (Environmental Protection Agency, Research Triangle Park, NC). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Active soil ventilation techniques have been tested in 24 block-wall basement houses in eastern Pennsylvania having significantly elevated indoor radon concentrations, generally above 740 becquerels per cubic meter (Bq/m^3). The results indicate that radon levels can be reduced substantially (often below the US Environmental Protection Agency (EPA) guideline of 148 Bq/m^3) if effective suction can be drawn on the soil underneath the concrete slabs of these houses. Such effective suction appears achievable when either: (a) the house has a complete loop of drain tile around its footings for water drainage purposes, and suction is drawn on that loop; or (b) a sufficient number of suction pipes can be inserted at the proper locations into the crushed rock or the soil underneath the slab.

22775 (DOE/ER/60493—1-Vol.2, pp 347-350) **Exposure to radon in Swedish dwellings - attitudes and elimination.** Jansson, B.; Tholander, M.; Axelson, O. (County Council of Skaraborg, Skoevde, Sweden). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Owners of 208 dwellings with radon daughter concentrations of 400 Bq/m^3 EER or above were asked by mailed questionnaires about attitudes and measures of elimination. The response rate was 90.4% and some steps of elimination had been taken in 83 dwellings. For the remaining houses, no improvements had been made because of financial problems, lack of technical advices and doubts about radon daughter exposure as a health hazard. The results of this study suggest the need to more definitely assess the risk through epidemiologic studies, more information about technical solutions is required as well as a better financial support to house-owners.

22776 (DOE/ER/60493—1-Vol.2, pp 351-354) **Some radon measurements indoors and in ground in Sweden.** Joensson, G. (Univ. of Lund, Sweden). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The main indoor radon sources in Sweden are the ground, the building material and the tap water. An investigation is performed in houses where the radon sources are the ground and the building material. Measurements of the radon and radon daughter concentrations are made indoors and in the ground around the houses with plastic track detectors. The investigated houses are single unit houses. The result indicates a possibility to identify the radon source.

22777 (DOE/ER/60493—1-Vol.2, pp 355-359) **Reduction of radon progeny concentration by means of unipolar air ionization.** Keskinen, J.; Lehtimaeki, M.; Janka, K. (Tampere Univ. of Technology, Finland). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Studies have been conducted on the effect of unipolar air ionization on the radon progeny concentration. In measurements done in a laboratory test room the effect of ion source efficiency, polarity of the source, relative humidity and aerosol particle concentration were studied. Increasing ion source efficiency led to a greater reduction of radon progeny concentration. With large particle concentration the reduction caused by ionization was more prominent than with clean air, although the absolute concentration remained higher. The results also showed the importance of ion source polarity: as expected, positive ionization was far more effective in removing the airborne radon daughters.

22778 (DOE/ER/60493—1-Vol.2, pp 360-364) **Enhancement of exposure to radon progeny as a consequence of passive smoking.** Moghissi, A.A.; Seiler, F.A.; Dellarco, M.J. (Institute for Regulatory Science, Alexandria, VA). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Among indoor air pollutants, radon and tobacco smoke take dominant positions. Because radon decay products have a relatively short residence time in air, the extent of the equilibrium between radon and its daughter products is linearly proportional to the carcinogenic risk, at least at low exposure levels. The relevant factor is the equilibrium factor F. This paper discusses the enhancement of radon exposure (F) as a result of the presence of particulate matter originating from tobacco smoke. The presence of tobacco smoke provides a mechanism for the radon progeny to be attached to inhalable particles and to remain in indoor air for a prolonged time. The results of our study indicate a significant increase in F as a consequence of passive smoking. These modeling efforts are consistent with the experimental data reported previously.

22779 (DOE/ER/60493—1-Vol.2, pp 365-369) **Building materials as source of exposure in houses.** Quindos, L.S.; Fernandez, P.L.; Soto, J. (Univ. of Cantabria, Spain). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The natural radioactivity due to the presence of Ra-226, Th-232 and K-40 in conventional building materials has been measured by gamma spectrometry. The average specific concentrations of these materials are reported and compared with the values found in other countries. A simple model is applied to the results to calculate the external irradiation for people living in a common spanish house constructed with these materials. The results are examined in the light of standards for indoor exposure adopted in the Federal Republic of Germany and the criteria set up in the OECD/NEA report 1979.

22780 (DOE/ER/60493—1-Vol.2, pp 370-375) **Use of diagnostic measurements to enhance the selection and effectiveness of radon mitigation for detached dwellings.** Sanchez, D.C.; Hubbard, L.M.; Harrje, D.; Turk, B.H. (Environmental Protection Agency, Research Triangle Park, NC). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The development of appropriate and cost effective radon mitigation for a specific house is ultimately tied to the degree to which we understand the source of the indoor radon problem, how house characteristics affect radon entry rates, and how candidate mitigation systems influence radon entry processes. Diagnostic measurements and procedures are discussed which allow for qualitative and quantitative assessments of water, materials, and soil as sources of radon and the assessment of soil-gas-borne radon flow potentials related to indoor/outdoor differential pressure driving forces and soil-air permeability. The discussed diagnostics are being developed and tested as part of an intensive State and Federal government study of radon entry and mitigation processes in 14 Piedmont New Jersey houses.

22781 (DOE/ER/60493—1-Vol.2, pp 376-380) **Ventilation measures in single-family houses with high radon concentrations.** Strindehag, O.; Norell, L. (Flaekt AB, Joenkoeping, Sweden). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Examples of ventilation systems installed in existing single-family houses with high radon concentrations are given in this paper. The radon originates from the building material in one of the houses and from the soil in the others. Measurements show that the radon concentration has decreased to an acceptable level in all these houses after installation of the ventilation systems.

22782 (DOE/ER/60493—1-Vol.2, pp 383-387) **Increased indoor radon levels due to actinide containing mineral collections displayed in living areas.** Burkart, W.; Crameri, R. (Swiss Federal Institute for Reactor Research, Wuerenlingen). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Collection of minerals ranging from quartz to uranium or thorium based crystals is a quite widespread hobby in Switzerland. Radon emanation from stones displayed in show cases or on open shelfs in the living area may contribute considerably to elevated radon levels in the indoor air. Time averaged radon gas measurements in 33 homes of subscribers to a journal for mineral collectors showed an unexpected statistically significant increase of 98.05 Bq/m^3 in the radon level of the room containing the collections compared to the levels detected in a control room on the same floor. Using UNSCEAR 82 conversion factors, the additional effective dose equivalent contracted was estimated to be an average of 2.9 mSv per year. Remedial actions for mineral collections displaying actinide containing crystals and amorphous precipitations are required.

22783 (DOE/ER/60493—1-Vol.2, pp 388-392) **Radon source rate measurements using multiple perfluorocarbon tracers.** D'Ottavio, T.W.; Dietz, R.N.; Kunz, C.; Kothari, B. (Brookhaven National Lab., Upton, NY). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2). Contract AC02-76CH00016.

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

An all passive monitoring system utilizing α-track detectors for radon and perfluorocarbon tracer (PFT) samplers for ventilation has been used to measure radon entry rates for 60 homes located within four separate areas of New York State (USA). Each home was divided into two or three zones so that multiple PFTs and multizone mass balance models could be used to compute zonal radon source rates. The whole house radon source rate for all 60 homes, averaged for a 2-7 week time period during the winter of 85-86, had a geometric mean of 4.94 Bq/s and an arithmetic mean of 10.0 Bq/s. Zonal mass balance equations applied to a tracer emitted in the soil outside 45 of the homes showed that, on average, 55% of the emitted tracer actually entered the house. Diffusion alone cannot account for such a high value.

22784 (DOE/ER/60493—1-Vol.2, pp 393-397) **Radon levels in 300 houses in Roane County, Tennessee.** Dudney, C.S.; Hawthorne, A.R.; Bull, L.A.; Cohen, M.A.; Daffron, C.R.; Orebaugh, C.T.; Harper, J.P. (Oak Ridge National Lab., TN). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2). Contract AC05-84OR21400.

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

In the winter of 1985 and summer of 1986, integrating radon monitors were placed in nearly 300 houses in a county in Eastern Tennessee (USA). Monitors were most frequently placed on top of the refrigerator in the kitchen but some were placed in basements.

Average levels were higher in the winter than in the summer and levels were higher in basements than in other locations. Preliminary analysis of the spatial distribution of the radon results suggest that there is a significant clustering of houses with higher levels of radon.

22785 (DOE/ER/60493—1-Vol.2, pp 398-402) **Distribution of radon levels in New York state homes.** Hartwell, T.D.; Perritt, R.L.; Sheldon, L.S.; Cox, B.G.; Smith, M.L.; Rizzuto, J.E. (Research Triangle Institute, Research Triangle Park, NC). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The results of a Statewide survey conducted to determine the distribution of radon concentrations in the main living areas of single-family, owner-occupied homes in New York State are presented. The participants were selected by a random-digit-dialing procedure resulting in a telephone interview. The track-etch detectors were mailed to the participants and returned after two months.

22786 (DOE/ER/60493—1-Vol.2, pp 403-408) **Experimental studies on the indoor radon and radon daughter concentrations build-up in Japanese houses.** Ikeda, K.; Yoshizawa, S.; Komine, H.; Kaminaka, S.; Abe, S. (Institute of Public Health, Tokyo, Japan). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Measurements of radon and radon daughter concentrations along with other factors, such as, ventilation rates, wind velocity, radon generation rates from building materials, amount of radium contained and indoor and outdoor temperatures and humidities, were conducted in a simple block-shaped experimental house in order to study concentration build-up mechanism of the radon released from building materials and soil underneath the house. Results showed that the most important factor for radon build-up was ventilation rate of the room. The data was compared to the results of seven actual houses and a model house of prefabricated house manufacturer and was found to be considerably high. Theoretical analysis was also made to testify the mass balance of radon in the room.

22787 (DOE/ER/60493—1-Vol.2, pp 409-413) **Indoor radon in three similar two-story houses with different ventilation systems.** Kokotti, H.; Raunemaa, T. (Univ. of Kuopio, Finland). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The maximum concentrations (60-430 Bq/m^3) of indoor radon were observed during a drying-out period just before the tenants moved in. The house with mechanical exhaust had the highest concentrations, the house with mechanical supply and exhaust the lowest ones. During winter and spring average radon concentrations in the houses were below 100 Bq/m^3. High radon concentrations were observed in underfloor sites inside the houses. In the house with mechanical exhaust three times indoor concentration was obtained. The average air exchange rates of the dwellings varied between 0 1-0.9 times per hour. Mean radon exhalation rate for concrete was 28 Bq/m^{2}h from these results.

22788 (DOE/ER/60493—1-Vol.2, pp 414-418) **Indoor radon: the diurnal cycle.** Kunz, C. (New York State Dept. of Health, Albany). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The concentration of indoor radon often exhibits a diurnal cycle with a minimum concentration at sunset and a maximum concentration at sunrise. This radon cycle has been related to the changing differential between indoor and outdoor temperatures which cause daily cycling of the stack effect. The different soil gas fractions of the infiltrating air resulting from the stack effect, wind, and occupant activities is used to explain diurnal and seasonal changes in indoor radon concentrations.

22789 (DOE/ER/60493—1-Vol.2, pp 419-424) **Influence of ventilation in rooms upon the effective dose equivalent from inhalation of ^{222}Rn and their short lived daughters.** Mocsy, I.; Fulea, C.; Simon, K. (Institute of Hygiene and Public Health, Cluj-Napoca, Romania). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Results are presented of measurements of the activity concentrations of ^{222}Rn and its short-lived decay products in apartments with prefabricated panel walls and simultaneously in the open air. The median value of the ^{222}Rn concentrations in the open air was found to be about 7,6 Bq m^{-3} ranging from 2,7 up to 10,5 Bq m^{-3}. The variations of the ^{222}Rn due to ventilation were investigated by measurements inside a room with very poor ventilation (after 48 hours windows and doors closed) 166 Bq m^{-3} and a room with strong ventilation 31 Bq m^{-3}. The equivalent dose for members of the public due to inhalation of radon's short lived daughters indoors was about a factor of 4,4 higher than the dose calculated for members in open air.

22790 (DOE/ER/60493—1-Vol.2, pp 425-429) **Experience from indoor radon-daughter limitation schemes in Sweden.** Swedjemark, G.A.; Wahren, H.; Maekitalo, A.; Tell, W.; Melander, E. (National Institute of Radiation Protection, Stockholm, Sweden). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

In Sweden a limitation scheme for radon daughters has been in operation since 1980. This paper describes the limitation scheme. The radon daughter concentrations found by the local authorities up to 1986 in their search for houses with levels above the limit is compared with the results from a previously reported country-wide study carried out during the years 1980-1982 with the aim of being representative. Up to November 1986 more than 40,000 homes had been investigated and of those about 4600 had radon daughter concentrations above 400 Bq/m^3 and several hundred had levels above 2000 Bq/m^3.

22791 (DOE/ER/60493—1-Vol.2, pp 430-436) **Study on indoor radon and radon daughter concentrations in Hokkaido of Japan.** Yokoyama, S.; Ochifuji, K. (Hokkaido Univ., Sapporo, Japan). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The authors examined several aspects of the filter pack method and extended its application for field survey. By the modified filter pack method Rn daughter concentrations in 26 houses were measured during the autumn and the winter in Hokkaido, where energy-efficient houses are increasing remarkably. The types of houses were wooden, concrete single and concrete apartment houses. The concentration of concrete single houses in winter was higher than those of the other house types. Annual variations of Rn concentration are investigated in representatives of three house types using the electrostatic Rn monitor method. The peak concentration of each house type in winter was considerably higher than that obtained in central Japan. Dynamic simulation of the effect of mechanical ventilation with kitchen fans and heat exchangers on indoor concentrations was performed.

22792 (DOE/ER/60493—1-Vol.3, pp 538-542) **Design of a statewide radiation survey.** Nagda, N.L.; Koontz, M.D.; Rector, H.E.; Nifong, G.D. (GEOMET Technologies, Inc., Germantown, MD). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The Florida Institute of Phosphate Research (FIPR) is sponsoring a statewide survey to identify all significant land areas in Florida where the State environmental radiation rule should be applied. Under this rule, newly constructed buildings must be tested for radiation levels unless approved construction techniques are used. GEOMET, a contractor a FIPR, is conducting two parallel surveys - a land-based survey and a population-based survey-to address the objective. The purpose of this paper is to describe the design of a large field study that includes radon measurements in about 6000 homes. Some preliminary results are reported.

22793 (INIS-BR—934, pp 129) **Study of thorium concentration in the air.** Cunha, K.M. da; Carvalho, S.M.M.; Barros Leite Filho, C.V. de; Baptista, G.B. (Instituto de Radioprotecao e Dosimetria, Rio de Janeiro, Brazil; Pontificia Univ. Catolica do Rio de Janeiro, Brazil. Dept. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701471/JAW. (CONF-8708216—).

From 10. workshop on nuclear physics in Brazil; Caxambu, MG, Brazil (26 Aug 1987).

22794 **(ORNL/TM—10671) Investigation of radon entry and effectiveness of mitigation measures in seven houses in New Jersey: Midproject report.** Matthews, T.G.; Dudney, C.S.; Monar, K.P.; Landguth, D.C.; Wilson, D.L.; Hawthorne, A.R.; Hubbard, L.M.; Gadsby, K.J.; Bohac, D.L.; Decker, C.A. (Oak Ridge National Lab., TN (USA)). Dec 1987. Contract AC05-84OR21400. 191p. NTIS, PC A09/MF A01; 1; GPO Dep. Order Number DE88006133/JAW.

A detailed radon mitigation study is in progress in 14 homes in the New Jersey Piedmont area. The principal goals are the refinement of diagnostic measurements for selection and implementation of mitigation systems, and the reduction of radon concentrations to acceptable levels inside the study houses. Monitoring stations were installed in each home in October, 1986. Instrumented measurements included: basement and upstairs radon; differential pressures across the basement/subslag, basement/upstairs and basement/outdoor interfaces; temperatures at basement, upstairs and outdoor locations; and central air handler usage. A weather station was located at one house, monitoring wind speed and direction; barometric pressure; precipitation; soil temperature; and outdoor temperature and relative humidity. A time-averaged value of all of the above parameters was recorded every 30 min. Several additional parameters were monitored on an intermittent basis in all or selected homes. These include multizone air infiltration rates which have been measured in all homes using passive perfluorocarbon tracers (PFT) and in two homes using a constant concentration tracer gas system (CCTG). Total radon progeny, soil gas radon concentration and permeability characteristics, and gamma radiation levels were also monitored periodically in all study homes. 10 refs., 53 figs.

5006 Regulations

REFER ALSO TO CITATION(S) 21703, 22662, 22752, 22757

22795 (DOE/ER/60493—1-Vol.3, pp 521-525) **Development of a comprehensive indoor air quality program: the Minnesota experience.** Oatman, L.; Lane, C.A. (Minnesota Dept. of Health, Minneapolis). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

States have the primary responsibility for indoor air quality program direction, research, funding, and regulations. State governments have traditionally used a pollutant-by-pollutant approach in addressing indoor air quality issues. Minnesota's past response to indoor air problems has been reactive and uncoordinated. Minnesota is currently pursuing a more comprehensive approach to evaluate indoor air problems which requires close coordination between various state agencies and outside organizations. This approach recognizes the policy and technical complexities associated with indoor air quality. It requires an evaluation of the relationships between the different pollutants, the building design and operation processes, and occupant behavior. Two case studies, where a cooperative effort was used by state agencies to identify and correct indoor air problems, are summarized.

22796 (DOE/ER/60493—1-Vol.3, pp 533-537) **Indoor air quality: radon and formaldehyde.** Suess, M.J. (WHO Regional Office for Europe, Copenhagen, Denmark). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The WHO Regional Office for Europe organized a Working Group on Indoor Air Quality: Radon and Formaldehyde, held in Dubrovnik, Yugoslavia, 26-30 August 1985. With respect to indoor radon daughter concentrations (which are considerably higher than outdoors, and of the order of 2-5 Bq/m^3 equilibrium equivalent radon (EER) concentration), the Group recommended that, in general, buildings with concentrations of more than 100 Bq m^3 EER, as an annual average, should be considered for remedial action to lower such concentrations, it simple measures are possible. With respect to formaldehyde, it was recommended that an average daily indoor concentration of 0.12 mg/m^3 should not be exceeded.

22797 (DOE/ER/60493—1-Vol.3, pp 543-547) **Proposed joint US-Canada study of the factors leading to indoor air quality concerns in the non-industrial workplace.** Mage, D.T.; Walkinshaw, D.; Harper, J.; Teichman, K. (Environmental Protection Agency, Research Triangle Park, NC). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The recent phenomenon of widespread indoor environmental complaints in the modern non-industrial workplace (e.g., offices, schools, hospitals), known as the Sick Building Syndrome (SBS), has been reported worldwide. The symptoms associated with the SBS by the World Health Organization (WHO) are generally nonspecific and difficult to monitor objectively. In a disturbingly large number of buildings, current technologies have been unsuccessful in identifying the environmental agents and/or human factors responsible. This lack of success has led to recognition that no single organization has the necessary expertise that is needed to identify reasonable levels of exposure in the non-industrial workplace. Therefore, a joint cooperative research program is proposed between US and Canadian organizations to address the factors related to the SBS concerns.

22798 (DOE/ER/60493—1-Vol.3, pp 553-557) **Development of indoor air quality guidelines in Canada.** Armstrong, V.C.; Walkinshaw, D.S. (Dept. of National Health and Welfare, Ottawa). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The Canadian Department of National Health and Welfare, in collaboration with provincial agencies responsible for the management of air quality, has developed exposure guidelines for a number of airborne substances found in residences. Guidelines for some substances are expressed as numerical exposure limits; others are listed as practical measures that should be taken by occupants to reduce or avoid exposure to potentially toxic materials. The health basis for these guidelines and rationale for the action levels selected for formaldehyde and proposed for radon are described.

22799 (DOE/ER/60493—1-Vol.3, pp 573-577) **Elements of strategies for control of indoor air quality.** Nero, A.V. Jr. (Lawrence Berkeley Lab., CA). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3). Contract AC03-76SF00098.

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Strategies for control of indoor pollutant concentrations require development of three basic elements: a framework of objectives and associated guidelines and standards; means for identifying the portion of the building stock requiring attention, according to this guidance; and a structure for choosing technical control measures appropriate for various circumstances. These elements go beyond the characterization of indoor pollutants concentrations and health effects, or the development of control techniques themselves, and require explicit consideration of risks, strategies, and responsibilities. Attempts to control putative indoor air quality problems without proper development and consideration of strategic elements can lead to ineffective or even counterproductive efforts.

22800 (DOE/ER/60493—1-Vol.3, pp 584-588) **Smoking in the workplace - Canadian law.** Price, P.; Grossman, M. (Canadian Center for Occupational Health and Safety, Hamilton, Ontario). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

There is growing pressure on all levels of government in Canada for laws to protect the public and workers from environmental tobacco smoke (ETS). Some workers have attempted to use the general provisions of present Canadian occupational health and safety (OH & S) law for protection from ETS. A number of municipal by-laws have been enacted to control smoking in the workplace, specifically in office buildings and these seem to be effective, as far as they go. Federal and provincial OH & S law has yet to prove effective in protecting workers from ETS, and specific legislation restricting smoking in the workplace may be necessary.

22801 (DOE/ER/60493—1-Vol.3, pp 589-593) **Regulating smoking in public buildings and workplaces.** Thron, R.W.; Thompson, M.J.; Oatman, L. (Minnesota Dept. of Health, Minneapolis). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Minnesota was one of the first states to pass a law which regulates smoking in public buildings and workplaces. The law prohibits smoking, except in designated smoking-permitted areas, and is applicable to privately as well as publicly owned buildings. Topics to be discussed include a brief history of the law, the process used in adopting rules and regulations to implement the state law, subsequent revisions to the rules, consultation and enforcement activities, public acceptance of the law, and its implementation. This paper will also show that the adoption and implementation of nonsmoking laws and regulations can be achieved with a minimum amount of cost and effort.

22802 (PB—88-139357/XAB) **Volatile organic compound emissions in Western Europe: control options and their cost-effectiveness for gasoline vehicles, distribution, and refining.** (Concawe, The Hague (Netherlands)). 1987. 131p. (CONCAWE—6/87). NTIS, PC E03/MF A01.

See also PB—86-241189.

The report summarizes the conclusions drawn by CONCAWE from its recent work on volatile organic compound (VOC) emissions in Western Europe. The conclusions presented herein include technical and cost-effectiveness information to help in selecting measures and assigning priorities in the development of any regulations felt to be necessary to limit VOC emissions. Emphasis is given to the largest significant sources, and the report therefore concentrates more on emissions from cars and to a lesser extent on refineries and gasoline distribution systems.

51 ENVIRONMENTAL SCIENCES, TERRESTRIAL

REFER ALSO TO CITATION(S) 23224

5101 Basic Studies

REFER ALSO TO CITATION(S) 21638, 22160, 22558, 22679, 23130, 23196, 23201, 23202, 23203, 23204, 23205, 23206, 23207

22803 (DOE/ER/60399—1) **Ecophysiology and adaptation in desert shrubs.** Ehleringer, J.R. (Utah Univ., Salt Lake City (USA). Dept. of Biology). 1987. Contract FG02-86ER60399. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005405/JAW.

The carbon isotope ratios of nineteen warm desert shrub species were sampled monthly. Precise estimates of the water-use efficiency patterns of the species change through time were made. How carbon isotope ratios (measures of integrated water-use efficiency) change with respect to microhabitat (wash, slope and transition zone) were measured with respect to the relative distributions of species along this cline.

5102 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 20990, 20992, 22245, 22743, 22744, 22745, 22746, 22834, 23200, 23208

22804 (CONF-871113—4) **Review of methods for removing VOCs [volatile organic compounds] from the environment.** Singh, S.P.; DePaoli, D.W.; Begovich, J.M.; Ashworth, R.A.; Heyse, E.C. (Oak Ridge National Lab., TN (USA); Air Force Engineering and Services Center, Tyndall AFB, FL (USA)). 1987. Contract AC05-84OR21400. 25p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002603/JAW.

From American Institute of Chemical Engineers annual meeting; New York, NY, USA (15 Nov 1987).

Technologies which have been employed for the removal of VOCs from the environment are air stripping, biological treatment, carbon adsorption, chemical oxidation, in situ soil venting, and membrane separation. This paper provides a review of the status of these technologies with particular emphasis on air stripping with emission control and in situ soil venting. 67 refs., 5 figs.

22805 (DOE/CH/10093—6, pp 97) **Biotreatment of MSW (municipal solid waste) ash.** Wichlacz, P.L. (EG & G Idaho, Inc., Idaho Falls). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

This proposed research is designed to identify and increase the understanding of various factors capable of affecting metal solubilization from MSW. This knowledge can then be applied to better treatment of MSW ash residues. The following tasks have been defined to accomplish the project objectives: a heap leach study will be performed to monitor leachate generation in a larger scale and more natural situation than previous laboratory tests to determine if the effects of leaching factors identified in the laboratory are similar under more natural conditions; bench-scale batch and column leaching studies will be performed to identify the factors that play a large role in the solubilization of metals from MSW ash; a tank leaching apparatus will be constructed and operated by controlling parameters identified above as the primary contributors of metals solubilization from MSW ash.

22806 (PB—88-131008/XAB) **Physics of immiscible flow in porous media. Final report, October 1984-October 1987.** Parker, J.C.; Lenhard, R.J.; Kuppusamy, T. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA)). Nov 1987. 149p. NTIS, PC A07/MF A01.

Conceptual formulation, numerical implementation and experimental validation of a model for the movement of organic

chemicals introduced into soils as nonaqueous phase liquids via surface spills or leakage from subsurface containment facilities were addressed. Relationships between fluid pressures (P), saturations (S), and permeabilities (k) were developed. Relative permeability-saturation relations are predicted from the scaled S-P function, which is assumed to reflect the pore-size distribution of the medium. Procedures were developed for the direct measurement of fluid pressures and saturations in three-phase systems. Validation studies indicated the k-S-P model provides a reasonable description of the system behavior under the imposed experimental conditions and may be satisfactorily calibrated using relatively simple procedures.

22807 **(PB—88-143441/XAB) Acid-deposition research program. Volume 2. Effects of acid-forming emissions on soil microorganisms and microbially-mediated processes.** Visser, S.; Danielson, R.M.; Parr, J.F. (Acid Deposition Research Program, Calgary (Alberta)). Feb 1987. 94p. (ADRP-B—02-87). NTIS, PC E04/MF A01.

See also PB—88-143433, and PB—88-143458.

The interactions of soil physical, chemical, and biological processes are ultimately expressed in a soil's fertility and its capacity for plant production. Consequently, much of the research conducted to date regarding the impact of acid-forming pollutants on soil properties has been geared towards possible effects on plant productivity. This trend continues in this paper where the effects of acidic deposition on microbial communities are reviewed in relation to potential impact on plant growth. The objectives of the review are to discuss: (1) The effects of acid-forming emissions (primarily S-containing pollutants) on microbial community structure with emphasis on qualitative and quantitative aspects; (2) The effects of acidic deposition on microbially mediated processes (i.e., community functions); (3) Acidification effects of pollutants on symbiotic and disease-causing microorganisms. The symbionts discussed include ectomycorrhizal fungi, vesicular-arbuscular mycorrhizal fungi, and N_2-fixing bacteria, particularly Rhizobium, while the disease-causing microorganisms will include those responsible for foliage, stem, and root diseases.

22808 **(PB—88-143466/XAB) Acid-deposition research program. Volume 4. Critical review of inorganic sulfur microbiology with particular reference to Alberta soils.** Laishley, E.J.; Bryant, R. (Acid Deposition Research Program, Calgary (Alberta)). Feb 1987. 60p. (ADRP-B—04-87). NTIS, PC E04/MF A01.

See also PB—88-143458, and PB—88-143474.

Contents include: the sulfur cycle - microbiology and biochemistry; ecological and economic activities of microbial inorganic sulfur oxidation and reduction; factors affecting the microbial oxidation of sulfur; the Alberta problem; prevention and reclamation of acid soils.

22809 **(PB—88-143474/XAB) Acid-deposition research program. Volume 5. Effects of acid deposition on soils in Alberta.** Turchenek, L.W.; Abboud, S.A.; Tomas, C.J.; Fessenden, R.J.; Holowaychuk, N. (Acid Deposition Research Program, Calgary (Alberta)). Feb 1987. 217p. (ADRP-B—05-87). NTIS, PC E08/MF A01.

See also PB—88-143466, and PB—88-143482.

The general objective of this report is a review of the literature which reflects the present state of knowledge of the short- and long-term effects of acidic and acid-forming substances from the atmosphere on soils, with particular emphasis on relating that literature to Alberta agronomic and forest ecosystems. The present concepts of the nature of soil acidity and related soil properties are initially discussed. The influences of soil acidity and of atmospheric acid deposition on soil properties including changes in pH, acid-neutralizing capacity, ion-exchange properties, organic matter, biogeochemical cycling, nutrient and toxic element availability, and others are discussed in the following section. The interactions of soil with acidic and acid-forming substances from the atmosphere are then briefly reviewed. There is a wide variety of soils in Alberta, a feature which poses great difficulties in assessing the effects of acidic deposition in the province. This diversity is revealed through an overview of the types, properties, and distribution of soils in Alberta. The overview also has the purpose of establishing a framework for discussion and extrapolation of possible effects of acid deposition on soils. The potential impacts of the deposition of varying levels of acidic and acid-forming substances on soils in Alberta are presented in the last major section of the report. A simple modeling approach is used to demonstrate potential changes in acidity, ion-exchange properties, and Al contents in a few representative profiles of the major soil orders. Soil sensitivities are briefly discussed along with qualitative assessments of impacts on other soil properties.

22810 **(PB—88-143508/XAB) Acid-deposition research program. Volume 8. Effects of acidic deposition on Alberta agriculture: a review.** Torn, M.S.; Degrange, J.E.; Shinn, J.H. (Acid Deposition Research Program, Calgary (Alberta)). Feb 1987. 181p. (ADRP-B—08-87). NTIS, PC E07/MF A01.

See also PB—88-143490, and PB—88-143516.

The review outlines the current knowledge of the effects of acidic deposition on agriculture, including plant response to pollutants, plant response to soil changes due to pollutants, and effects on interactions between plants and symbionts. Acidic deposition may trigger changes in crops, soils, and crop-symbiont interactions. The effects of wet and dry deposition on agricultural plants are discussed. In the discussions of dry deposition, the gaseous air pollutants considered are: the acidic gases SO_2 (sulfur dioxide) and NOx (oxides of nitrogen), the oxidant O_3 (ozone), and H_2S (hydrogen sulphide). In the discussion of the effects on agricultural plants attention is paid to: direct effects on plant physiology; foliar responses such as visible injury, fertilization, buffering, and leaching; crop growth; and, reproduction. Relative species sensitivity to foliar injury and changes in growth and yield were analyzed from available dose-response data. Because experimental conditions vary considerably and may have a significant influence on plant response, a review of experiment design factors was made to aid in data interpretation. Species important to Alberta agriculture are emphasized except where there is a limited amount of data on these species or where comparisons to other species increase understanding. The effects of pollutant combinations on agricultural plants are considered. The effects of acidic deposition on plant response to pollution-induced changes of the soil environment are also detailed. The effects of acidic deposition on plant-symbiont interactions are reviewed. Conclusions are given on the impact that atmospheric pollutants may have on Alberta agriculture.

22811 **(PB—88-857123/XAB) Polychlorinated biphenyls: occurrence in sediments and soils. January 1977-January 1988 (citations from the Selected Water Resources Abstracts data base). Report for January 1977-January 1988.** (National Technical Information Service, Springfield, VA (USA)). Jan 1988. 120p. NTIS PC N01/MF N01.

Supersedes PB—87-855102.

This bibliography contains citations concerning field and laboratory analyses of polychlorinated biphenyls in sediments and soils. Topics include site studies; chemical analyses of adsorption-desorption processes; decomposition in soils, including biodegradation; and bioaccumulation. Detection methods and equipment, and the impact of dredging in contaminated areas are also discussed. (This updated bibliography contains 207 citations, 28 of which are new entries to the previous edition.)

5103 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 21054, 21058, 21066, 21069, 21076, 21088, 21095, 21097, 21110, 21113, 21613, 22776, 23073, 23097, 23107

22812 **(DOE/ER/40048—203-L7) Rapid response of tree cellulose radiocarbon content to changes in atmospheric $^{14}CO_2$ concentration.** Grootes, P.M.; Farwell, G.W.; Schmidt, F.H.; Leach, D.D.; Stuiver, M. (Washington Univ., Seattle (USA)). [1987]. Contract AC06-81ER40048. 30p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004163/JAW.

A detailed radial profile for the ^{14}C concentration in tree cellulose, covering growth rings for the years 1962-1964, was obtained for a Sitka spruce of the US Pacific Coast using accelerator mass spectrometry. The tree cellulose ^{14}C closely follows atmos-

pheric $^{14}CO_2$ concentrations, responding to changes with a delay of not more than a few weeks. The delay in response is mostly due to the addition of between 13 and 28% of biospheric CO_2 to the canopy-air CO_2 used by the tree for stem cellulose. Delayed incorporation and the use of stored photosynthate of the previous fall appear less important. 63 refs., 4 figs., 3 tabs.

22813 **(IAE—4413/3) Radionuclide migration in food chains: camera principle.** Murzin, N.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1987. 20p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701572/JAW.

General and correct determination of the idea of "camera" was used to consider the construction of camera model of radionuclide migration in food chains for the cases of fast and slow radionuclide "mixing" among components of food chain, as well as for cases of fast radionuclide "washing". Errors, which occur in evaluation of radionuclide concentration in components of food chains due to camera model application were calculated for each of three considered cases. 18 refs.

22814 (INIS-mf—10846, pp 55) **Radioactivity of building materials used in Bulgaria.** Petkov, T.; Badulin, V.; Georgieva, Yu. (Meditsinska Akademiya, Sofia, Bulgaria). Nov 1984. (In Bulgarian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

22815 (INIS-mf—10846, pp 44) **Natural radioactivity of the Bulgarian Black Sea coast.** Minev, L.; Teofilov, S.; Kritidis, P.; Uzunov, I. (Sofia Univ., Bulgaria). Nov 1984. (In Bulgarian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

22816 (INIS-mf—10846, pp 44) **Area of the Black Sea coast with abnormally low gamma-background.** Minev, L.; Teofilov, S.; Kritidis, P.; Uzunov, I. (Sofia Univ., Bulgaria). Nov 1984. (In Bulgarian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

22817 (INIS-mf—10846, pp 89) **Radioecological investigations in Bad Gasten, Austria.** Teofilov, S.; Uzunov, I.; Stainhausler, P.; Eckl, E.; Pohl, I. (Sofia Univ., Bulgaria; Salzburg Univ., Austria). Nov 1984. NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

22818 **(JINR—18-86-708) Specific features of emanation, temperature and hydrodynamic fields in the epicentral zone of tectonic earthquake.** Ashirov, T.A.; Ishankuliev, D.; Ishankuliev, G.A.; Dzholos, L.V.; Merkina, K.I.; Tret'yakova, S.P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1986. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701140/JAW.

Submitted to the journal Izv. Akad. Nauk SSSR, Fiz. Zemli.

The randon field variation in loose deposits from the zone of the Cheleken-Kum-Dag fracture due to an earthquake with M=5.6 was studied using the nuclear track technique. The complex analysis of the variations of emanation, temperature and hydrodynamical fields was carried out. Abnormal changes in all the three fields during the Burun earthquake have been found, due to alternation in the rock structure of the central zone. 14 refs.; 4 figs.

22819 **(RISOe-R—541) Environmental radioactivity in the North Atlantic region. The Faroe Islands and Greenland included. 1985.** Aarkrog, A.; Boelskifte, S.; Dahlgaard, H.; Hansen, H.; Buch, E.; Christensen, G.C.; Hallstadius, L.; Rioseco, J.; Holm, E. (Risoe National Lab., Roskilde (Denmark)). Jun 1987. 83p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88752051/JAW.

Measurements of fallout radioactivity in the North Atlantic region including the Faroe Islands and Greenland are reported. Strontium-90 and cesium-137 was determined in samples of precipitation, sea water vegetation, various foodstuffs (including milk in the Faroes) and drinking water. Estimates are given of the mean contents of /sup 90/Sr a /sup 137/Cs in human diet in the Faroes and Greenland in 1985. Results from samplings of surface sea water and seaweed in the English Channel, the Fram Strait and along the Norwegian and Greenland coast are reported. Beside radiocesium and /sup 90/Sr some of these samples ha also been analysed for tritium, plutonium and americium. Finally technetium-99 data on seaweed and sea water samples collected in the North Atlantic region are presented. 14 refs.

5105 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 20983, 20984, 20985, 20986, 20987, 23208

22820 **(PB—88-139654/XAB) Setting priorities for abandoned-mine land research. Final report.** (National Academy of Sciences, Washington, DC (USA). Commission on Physical Sciences, Mathematics, and Resources). 1987. 113p. NTIS, PC A06/MF A01.

In FY 1987, Congress transferred the abandoned mine land (AML) research program and $1.9 million in funding from the Office of Surface Mining (OSM) to the Bureau of Mines (BOM). Subsequently the BOM asked National Research Council (NRC) to recommend research priorities and criteria for evaluating AML reclamation research proposals. The committee identified the highest-priority research problems which are: water quality; subsidence; mine waste; and revegetation, are ranked as the top four research priorities in all regions.

5106 Regulations

REFER ALSO TO CITATION(S) 21698, 21703, 22864, 22865, 22873, 22874

22821 **(PB—88-142476/XAB) Hazardous-waste bibliography.** (Environmental Protection Agency, Washington, DC (USA). Office of Emergency and Remedial Response). Oct 1987. 50p. (EPA—540/1-87/001). NTIS, PC A03/MF A01.

Also available from Supt. of Docs.

This Hazardous Waste Bibliography was prepared in response to numerous requests for a list of EPA documents relating to the clean-up of hazardous-waste sites. The purpose of this ongoing effort, begun by the Technology Transfer Task Force, is to collect technical materials that should be available to all Federal and State hazardous waste staffs and their libraries. The Office of Solid Waste and Emergency Response (OSWER) program offices and the Office of Research and Development (ORD) were asked to submit a list of technical and procedural documents relevant to their program's mission. The program offices then culled from the lists those documents they considered most helpful in carrying out their mission. The result is a listing of the most-relevant technical and procedural documents that have been produced by the hazardous-waste program offices and supporting ORD laboratories.

22822 **(PB—88-159926/XAB) Superfund Record of Decision (EPA Region 2): Waldick Aerospace Devices, Wall Township, Monmouth County, New Jersey, (first remedial action), September 1987. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 29 Sep 1987. 54p. (EPA/ROD/R—02-87/043). NTIS, PC A04/MF A01.

The Waldick Aerospace Devices (WAD) site is a 1.72-acre inactive industrial facility located in the Sea Girt Section of Wall Township, Monmouth County, New Jersey. The site consists of three buildings located on the northern, western and southern border. WAD was originally purchased and developed in the mid 1950's by Mr. Warren de Montmorency. The designated owner of the site since 1979 is KDD Realty Corporation of which Mr. de Montmorency is president. In 1979 the site was leased to Waldick Aerospace Devices, Inc. The firm manufactured and electroplated quick-release pins for the aerospace industry for five to six years. For at least the first three years of operations, waste water containing heavy metals and organic solvents was discharged directly onto the ground on either side of the southern corner of the main building. Additionally, spent machine oil was allowed to drain out of perforated drums onto the ground at the rear (western side) of the main building. In 1982, acting on information received from a former Waldick employee, the New Jersey Department of Environmental Protection (NJDEP) conducted an inspection of the Waldick facility.

22823 **(PB—88-159934/XAB) Superfund Record of Decision (EPA Region 2): Williams Property Site, Middle Township, Cape May, New Jersey, (first remedial action) September 1987. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 29 Sep 1987. 86p. (EPA/ROD/R—02-87/044). NTIS, PC A05/MF A01.

The Williams Property site, a 5.6-acre tract of land containing a single residence, is located in Middle Township, Cape May County, New Jersey. The site is wooded and surrounded by land zoned for agricultural and residential use. In 1979, approximately 150 drums of liquid chemical wastes and sludge were emptied on the Williams Property. The New Jersey Department of Environmental Protection (NJDEP) investigated to determine the nature and extent of the contamination and the impact of the spill on the environment, particularly the ground water. The results indicated extensive contamination of surficial sludge, contamination of soil and ground water with heavy metals and a wide variety of organic chemicals. In June 1980, NJDEP removed approximately 1,200 cubic yds of sludge and soil. Continued evidence of ground water contaminants forced the closing of the Williams' well in 1984. It was subsequently discovered that widespread dumping of refuse and construction debris had occurred on the site for years. This dumping may have contributed to ground-water contamination. Primary contaminants of concern include: bis (2-ethylhexyl) phthalate, PCE, methylene chloride, and xylene.

22824 **(PB—88-159967/XAB) Superfund Record of Decision (EPA Region 4): Palmetto Wood Preserving, Dixiana, Lexington County, South Carolina, (first remedial action), September 1987. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 30 Sep 1987. 55p. (EPA/ROD/R—04-87/026). NTIS, PC A04.

The Palmetto Wood Preserving (PWP) Site is located in the rural community of Dixiana, South Carolina. The 5-acre site is a decommissioned wood-preserving facility which operated between 1963 and 1985. PWP began operating in 1963 using a fluoride-chromate arsenate-phenol (FCAP) and an acid-copper-chromate (ACC) process. In 1980, Eastern Forest Products took over and switched to a chromate-copper-arsenate (CCA) process. Operations consisted of impregnating wood with a CCA solution under high pressure, and allowing the wood to drip-dry under normal conditions. Beginning in December 1981, the South Carolina Department of Health and Environmental Control (SCDHEC) received complaints of green liquids running off the PWP site during heavy rainfall. Subsequent soil sampling conducted by SCDHEC indicated the presence of high concentrations of chromium. Pentachlorophenol (PCP) and dinitrophenol residues were also detected. Well-water sampling showed no evidence of contamination. In April 1983, a private well was found to contain high levels of chromium and copper. As a result of the findings, SCDHEC issued a Consent Order requesting Palmetto Wood Preserving to determine the extent of soil and ground water contamination. Primary contaminants of concern include chromium and arsenic.

22825 **(PB—88-159975/XAB) Superfund Record of Decision (EPA Region 5): Liquid Disposal, Inc., Utica, Michigan, (first remedial action), September 1987. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 30 Sep 1987. 67p. (EPA/ROD/R—05-87/051). NTIS, PC A04/MF A01.

Liquid Disposal, Inc. (LDI) is a 6.8-acre site located in a residential/light industrial area in Shelby Township, Michigan. LDI is bordered by the Clinton River and its flood plain, the Shadbush Tract Native Study Area, and automobile junkyards. The site was first used as a source of sand and gravel prior to becoming a landfill around 1964. Between 1968 and 1982, LDI operated as a commercial incinerator of liquid waste. During this time, the site contained a large volume of hazardous substances stored in the waste oil and scrubber lagoons, ash sludge piles, above- and below-ground storage tanks and in 55-gallon drums. Since 1982, EPA has completed four immediate removal actions. As a result of these actions, no surface waste sources exist at the site. However, several hundred waste sample jars, old incinerator parts, emptied tanks, wooden pallets, miscellaneous containers and other debris remain onsite. Currently, on and offsite soil and ground water (the upper aquifer) are contaminated with a wide variety of organic and inorganic chemicals. Onsite concentrations are generally higher than offsite. The primary contaminants of concern include: VOCs, semivolatile organics, PCBs, barium, cadmium, and lead.

22826 **(PB—88-160007/XAB) Superfund Record of Decision (EPA Region 5): Schmalz Dump, Harrison, Wisconsin, (second remedial action), September 1987. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 30 Sep 1987. 52p. (EPA/ROD/R—05-87/054). NTIS, PC A04/MF A01.

The Schmalz Dump site occupying approximately seven acres of the Waverly Beach wetlands area, is located on the north shore of Lake Winnebago in the town of Harrison, Wisconsin. Industries dumped wastes at various locations along the north shore of Lake Winnebago for several years. Mr. Gerald Schmalz, the previous site owner, began filling his property in 1968. Records show that wastes hauled there consisted of solid wastes, car bodies, stone, trees, pulp chips and mash. Between 1972 and 1973 the site accepted fly ash and bottom ash from Menasha Utility, and in 1978 and 1979 Schmalz accepted the demolition debris of a building owned by the Allis-Chalmers Corporation. Initial onsite sampling in early 1979 determined that an area containing the Allis-Chalmers debris was contaminated with concentrations of PCBs as high as 3,100 ppm with lead and chromium also detected in relatively high concentrations. In August 1985, a ROD was signed approving an operable unit to address the PCB contamination. This second operable unit addresses soil contamination with lead and chromium.

22827 **(PB—88-160015/XAB) Superfund Record of Decision (EPA Region 5): Marion/Bragg Landfill, Marion, Indiana, (first remedial action), September 1987. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 30 Sep 1987. 74p. (EPA/ROD/R—05-87/055). NTIS, PC A04.

The Marion/Bragg Landfill is a 72-acre site located near the southeastern city limits of Marion, Indiana. The site is bordered on the north and east by the Mississinewa River. Main features of the site include a 45-acre landfill and a 15-acre pond. From 1935 to 1961 the site was used as a sand and gravel quarry, and from 1949 to 1970 portions of the site, leased by Radio Corporation of America and Bragg Construction Company, were used for industrial and municipal waste disposal, respectively. Throughout this period, the Indiana State Board of Health (ISBH) noted the disposal of acetone, plasticizers, lacquer thinner, and enamels. Drummed wastes were also accepted and contents were allegedly emptied from the drums and worked into the landfill waste with a bulldozer, causing several fires on site. Drums were allegedly rinsed and resold. In 1975 Bragg Construction company ceased operation of the landfill. In 1975, Waste Reduction Systems constructed a transfer station to properly transfer solid wastes to an approved landfill. The transfer station was closed in 1977.

22828 **(PB—88-857560/XAB) Wetlands legislation and management. January 1977-January 1988 (citations from the Selected Water Resources Abstracts data base). Report for January 1977-January 1988.** (National Technical Information Service, Springfield, VA (USA)). Feb 1988. 186p. NTIS PC N01/MF N01.

Supersedes PB—87-855250.

This bibliography contains citations concerning Federal and state legislation governing coastal and fresh water wetlands. Studies of regional regulations and management of specific cites are included. Reconciling environmental considerations with economic pressures and landowners' rights is discussed. Wetlands restoration projects, conservation projects, and development plans are presented. Many citations discuss wetlands management and law in relation to the Clean Water Act. (This updated bibliography contains 351 citations, 17 of which are new entries to the previous edition.)

52 ENVIRONMENTAL SCIENCES, AQUATIC

5201 Basic Studies

22829 **(CONF-870835—1) Strategies and difficulties of applying models to aquatic populations and food webs.** DeAngelis, D.L. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 30p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002804/JAW.

From 72. annual meeting of the Ecological Society of America; Columbus, OH, USA (9 Aug 1987).

This report describes problems that occur during the development of mathematical models that can be tested with a hypothesis. The author selected as his primary example the relationships between increased levels of atmospheric CO_2 and declining fisheries stocks. Other examples are more briefly discussed. The author reviews the current scope of biological modeling and the direction that current research appears to be taking. (TEM)

22830 **(NP—7900642) The ecology of the coastal marshes of western Lake Erie: A community profile.** Herdendorf, C.E. (Ohio State Univ., Columbus (USA). Center for Lake Erie Area Research; Fish and Wildlife Service, Slidell, LA (USA). National Wetlands Research Center). Feb 1987. 183p. NTIS, PC E07/MF A01. Order Number TI87900642/JAW.

Includes 1 sheet of 24x reduction microfiche.

Lake Erie, the southernmost of the Laurentian Great Lakes, is narrow and relatively shallow in comparison to other Great Lakes. The lake experiences extreme water level fluctuations and storm energy restricts the development of wetlands to protected areas within embayments, lagoons, or behind barriers. However, coastal marshes of western Lake Erie fringe the shorelines of Michigan, Ohio, and Ontario and encompass an area of 268 km^2. This publication reviews the ecological data and information on the wetlands of Lake Erie, which are some of the more productive areas in the Great Lakes ecosystem. The geologic history of the Lake Erie leading to the development of wetlands, the present environment, and present wetland distribution are presented as background in the opening chapters. Biological information available for the Lake Erie wetlands is discussed in detail, and ecological processes contributing to the evolution of wetlands, biological production, and community organization in the wetlands are examined. A chapter on applied ecology addressing issues, such as wetland loss, values of wetlands to fish and wildlife, management, and future prospects for Lake Erie wetlands, completes the publication.

5202 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 20891, 20892, 20893, 20894, 20895, 20896, 20897, 20988, 20990, 20992, 21093, 22185, 22612, 22685, 22737, 22743, 22804, 22805, 22806, 22820, 22977, 22980, 22982

22831 **(AD-A—187486/6/XAB) In-situ biological treatment test at Kelly Air Force Base. Volume 2. Field test results and cost model. Final report, 1 June 1985-31 May 1987.** Wetzel, R.S.; Durst, C.M.; Davidson, D.H.; Sarno, D.J. (Science Applications International Corp., McLean, VA (USA)). Jul 1987. 171p. NTIS, PC A08/MF A01.

See also Volume 3, AD-A186 279.

The objective of this effort was to field test in-situ biodegradation to treat aquifer contaminants. In-situ biodegradation is enhanced by stimulating in indigenous subsurface microbial population by the addition of nutrients and an oxygen source to promote degradation of organic contaminants. In-situ treatments affects contaminants with a mixture of organic and inorganic chemicals. The treatment system consisted of an array of nine pumping wells and four infiltration wells. These wells circulated groundwater and transported the treatment chemical s throughout the 2800-square-feet treatment area. Oxygen was supplied by means of a hydrogen peroxide solution. Nutrients were principally ammonium and phosphate salts. The system was operated for 9 months. Data showed evidence of both aerobic and anaerobic biodegradation. Decreases in tetrachloroethylene and trichloroethylene concentrations in groundwater correlate with anaerobic microcosm tests. Aerobic biodegradation was indicated by acid and carbon dioxide production, and increases in petroleum hydrocarbon concentrations in groundwater, However, any biodegradation of these hydrocarbons was too small to be quantified. The study confirms that indigenous bacteria can be enhanced to degrade organic contaminants. The problems with in situ treatment are primarily those of delivery of chemicals and minimizing adverse reactions between injection chemicals and subsurface minerals.

22832 **(EPRI-EA—5342) Groundwater assessment modeling under the resource conservation and recovery act: Final report.** Whelan, G.; Brown, S.M. (Pacific Northwest Lab., Richland, WA (USA)). Jan 1988. Contract AC06-76RL01830. 269p. NTIS, PC A12/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303; 1; GPO Dep. Order Number DE88005287/JAW.

This report identifies typical features that groundwater and exposure analysis codes should possess for use in a risk analysis. By assessing typical mathematical codes that analyze contaminant transport in groundwater systems (i.e., partially saturated and saturated zones) and human exposure, we provide a basis that risk analysts can use to choose components of the assessment framework. Two levels of modeling sophistication are also identified: Level I and Level II codes. Level I codes represent preliminary or screening level codes that are used in a risk assessment exercise; they have minimal data requirements and tend to be based on analytical or semianalytical solutions. Level II codes are detailed mathematical codes; they generally have extensive data requirements and tend to be based on algorithms that are solved by numerical techniques (e.g., finite element and finite difference). The results of this effort will provide the analyst with some guidance in the selection and use of computer codes. The methodology was applied to a test case to demonstrate its implementation and use. This test case highlights the migration and fate through the groundwater system of selenium from a waste disposal facility for a coal-fired power plant. Level I and Level II assessments are compared for several conditions that might exist at the site. The comparison illustrates the differences between the level of effort required and the resolution of results for Level I and Level II assessments. 325 refs., 150 figs., 23 tabs.

22833 **(PB—88-126420/XAB) Numerical model for three-dimensional hydrodynamic transport: documentation of the computer program.** Paul, J.F.; Nocito, J.A. (Environmental Protection Agency, Duluth, MN (USA). Environmental Research Lab.). Nov 1987. 169p. (EPA—600/3-87/043). NTIS, PC A08/MF A01.

As part of a research effort by the U.S. Environmental Protection Agency to study the dispersion of pollutants in aquatic systems, a numerical model has been developed that is capable of realistically describing physical transport in lakes, embayments, nearshore marine coastal areas, and riverine and thermal outfall plumes. The model is formulated from the time-dependent, three-dimensional convective-diffusive equation. The model is designed to be compatible with a separate time-dependent, three-dimensional, variable-density, hydrodynamic model. The details of the hydrodynamic model have been documented in a separate report. The report provides the documentation for the computer program for the numerical model. Three detailed case studies are presented to demonstrate the utility of the model. These case studies are applications to Lake Erie, an idealized lake, and a surface thermal discharge.

22834 **(PB—88-131511/XAB) Health-risk comparison between groundwater transport models and field data.** Hwang, S.T. (Environmental Protection Agency, Washington, DC (USA). Office of Health and Environmental Assessment). 1986. 9p. (EPA—600/J-86/424). NTIS, PC A02/MF A01.

Pub. in Environmental Progress, Vol. 5, No. 1, 66-70(Feb 1986).

The potential of ground-water contamination is one of the major concerns over land disposal of hazardous waste. Risk assessment requires information on ground-water concentrations of contaminants at the exposure location. Results are presented of case studies comparing health risk assessment and plume delineation based on state-of-the-modeling and monitoring data.

22835 **(PB—88-133624/XAB) Expert advisor for the QUAL2E water-quality model.** Barnwell, T.O.; Brown, L.C.; Marek, W. (Environmental Protection Agency, Athens, GA (USA). Environmental Research Lab.). Dec 1987. 14p. (EPA—600/D-87/352). NTIS, PC A03/MF A01.

Computer modeling is becoming an integral part of decision making in water-pollution control. Problems increasingly involve complex interactions among elements of the environment and large, multi-media modeling systems must be built to understand these interactions. Expert systems is an innovative methodology that can assist in building, using, and interpreting the output of these models. The paper reviews the use and evaluates the potential of expert systems technology in environmental modeling and describes elements of an expert advisor for the stream water-quality model QUAL2E. QUAL2E has a long history of use both in the United States and worldwide and is a proven, effective modeling tool for analyzing the dissolved oxygen balance in a stream or river. Because of the widespread usage, a body of experience and empirical knowledge about the computer program has been gained that is ideal for codification in an expert system.

22836 **(PB—88-133749/XAB) National Surface Water Survey: Eastern Lake Survey (Phase 1 - synoptic chemistry). Quality-assurance report.** Best, M.D.; Drouse, S.K.; Creelman, L.W.; Chaloud, D.J. (Lockheed Engineering and Management Services Co., Inc., Las Vegas, NV (USA)). Dec 1986. 193p. NTIS, PC A09/MF A01.

See also PB—86-232584.

This report provides an overview of the quality-assurance activities and results of the Eastern Lake Survey - Phase I. The quality-assurance program used a combination of blank, duplicate, and audit samples to provide an external check on the data quality of 32 physiochemical parameters measured and to allow early detection of problems in sample collection, processing, and analysis. Field sampling, field and analytical laboratory, and data-base quality-control protocols also were standardized to ensure the reliability of the data. The statistical analysis of the verified data set included estimates of instrumental and system detection limits, system decision limits, overall and analytical within-batch precision, and overall and analytical among-batch precision.

22837 **(PB—88-133772/XAB) Development of a combined quantity and quality model for optimal groundwater management. Technical completion report.** Peralta, R.C.; Solaimanian, J.; Prathapar, S.A.; Griffis, C.L. (Arkansas Univ., Fayetteville (USA). Water Resources Research Center). Jun 1987. 28p. (PUB—127). NTIS, PC A03/MF A01.

A procedure is presented for incorporating solute transport as linear constraints within computer models for optimizing regional groundwater extraction strategies. The MODCON modeling procedure uses linear goal programming, embedded linearized equations for flow and solute transport, and a MOC simulation model. The MODCON procedure develops steady groundwater extraction strategies that will satisfy future groundwater quality constraints while simultaneously causing future piezometric heads to be as close to current heads as possible. The procedure is applied to a 160-square-mile area in southeastern Arkansas.

22838 **(PB—88-133780/XAB) Detroit, Michigan area sediment survey, 1982.** Pranckevicius, P.E. (Environmental Protection Agency, Chicago, IL (USA). Great Lakes National Program Office). Jul 1987. 109p. (EPA—905/4-87/003). NTIS, PC A06/MF A01.

Twenty-eight sediment grab samples from the western bank of the Detroit River and three of its tributaries were chemically analyzed. Sampling sites were chosen to find worst-case conditions. High levels of conventional pollutants and metals were found throughout most of the study area. Hydrophobic organic contaminants found in a wide range of concentrations included: polynuclear aromatic hydrocarbons, polychlorinated biphenyls, various pesticides, and volatile organic compounds. Contaminant distributions suggest recent inputs from local sources. Highest contaminant levels were found in the Rouge River, the northern Trenton Channel and Conners Creek in the Belle Isle Area. The City of Detroit Wastewater Treatment Plant, combined sewer overflows, local steel and chemical industry and oil refineries are implicated as likely sources. Several contaminants including volatile organics, PCBs and hexachlorobenzene, seem to have major upstream sources, perhaps in Lake St. Clair or the St. Clair River.

22839 **(PB—88-134218/XAB) Land-use effects on ground-water quality in carbonate-rock terrain. Technical completion report.** Steele, K.F.; Adamski, J.C. (Arkansas Univ., Fayetteville (USA). Water Resources Research Center). Jun 1987. 80p. (PUB—129). NTIS, PC A05/MF A01.

A control site with a natural setting and an experimental site with significant agriculture land use were studied in the Ozark Region of Arkansas in order to determine the effect of land use on water quality in a carbonate rock terrain. Ground-water samples were collected primarily from springs during three seasons. All three seasonal collections exhibited statistically higher NO_3 (2.31 versus 0.81 mg/l) and Cl (9.9 versus 2.7 mg/l) concentrations in the experimental sites. During the winter and spring collections, the experimental site also exhibited statistically higher concentrations (0.5 to 3x) of PO_4, SO_4, Na, K and Ca. Three springs were also sampled periodically following a rain event of 10 cm.

22840 **(PB—88-135876/XAB) AGNPS, Agricultural Non-Point-Source Pollution Model: a watershed analysis tool. Research report.** Young, R.A.; Onstad, C.A.; Bosch, D.D.; Anderson, W.P. (Agricultural Research Service, Albany, CA (USA). Western Utilization Research and Development Div.). Dec 1987. 83p. (CONSERVATION/RR—35). NTIS, PC A05/MF A01.

Agricultural Non-Point-Source Pollution Model (AGNPS) is a computer-simulation model developed to analyze the water quality of runoff from Minnesota watersheds. The model predicts runoff volume and peak rate, eroded and delivered sediment, and nitrogen, phosphorus, and chemical oxygen demand concentrations in the runoff and the sediment for single storm events for all points in the watershed.

22841 **(PB—88-137443/XAB) Aquatic-surface microlayer contamination in Chesapeake Bay. Final report.** Hardy, J.T.; Crecelius, B.A.; Antrim, L.D.; Kiesser, S.L.; Broadhurst, V.L. (Pacific Northwest Lab., Richland, WA (USA)). Aug 1987. 39p. NTIS, PC A03/MF A01.

The boundary between the atmosphere and the aquatic environment is an important biological habitat and a collection point for pollutants. The eggs and larvae of many fish and shellfish species float on, or come in contact with, the water surface throughout

their early development. The aquatic-surface microlayer serves as a concentration point for metal and organic contaminants that have low water solubility or are associated with floatable particles. Coal-fired power plants may release organic and metal contaminants into the environment that subsequently concentrate on the water surface. The objectives of this study were to (1) determine the present degree of aquatic surface microlayer pollution at selected sites in Chesapeake Bay, and (2) provide a preliminary evaluation of sources (including power plants) contributing to any observed contamination.

22842 **(PB—88-139944/XAB) Fate and transport of sediment-associated contaminants.** Medine, A.J.; McCutcheon, S.C. (Environmental Protection Agency, Athens, GA (USA). Environmental Research Lab.). Dec 1987. 113p. (EPA—600/D-87/356). NTIS, PC A06/MF A01.

Although sediments generally are considered to provide beneficial effects in terms of water quality movement through the sorption of pollutants from the water column, contaminated sediments also may result in adverse effects. The interactions of both metals and organic contaminants with suspended and bed sediments significantly affects the transport and transformation of these pollutants in streams and lakes. Information about these interactions is important in assessing hazards of pollutant exposure in freshwater systems. In the paper, research into the fate and transport of sediment-associated contaminants is reviewed.

22843 **(PB—88-140280/XAB) Treatment of municipal wastewaters by the fluidized-bed bioreactor process. Final report, May 1982-April 1986.** Scheible, O.K.; Grey, G.M. (Hydroqual, Inc., Mahwah, NJ (USA)). Dec 1987. 202p. NTIS, PC A10/MF A01.

A 2-year, large-scale pilot investigation was conducted at the City of Newburgh Water Pollution Control Plant, Newburgh, NY, to demonstrate the application of the fluidized-bed bioreactor process to the treatment of municipal wastewaters. The experimental effort investigated the ability of the process to treat municipal wastewater to secondary levels. Additionally, the studies evaluated the stability of the process under high hydraulic peak loads typical of combined sewer systems. An organic loading rate of 0.2 to 0.3 gm BOD/gm volatile suspended solids/day is suggested in order to meet secondary treatment levels. Suspended solids removals were relatively low through the reactor; the results indicate that final clarification would be required for the plant to meet a 30 mg/L TSS limitation. The system exhibited good stability under high short-term peak hydraulic loadings. Maximum to average raw flow ratios up to 5 could be handled without bed washout. Special reactor modifications to yield an expanded upper section allowed a ratio as high as 10 to 1 without loss of the bed.

22844 **(PB—88-143433/XAB) Acid-deposition research program. Volume 1. Surface-water acidification literature review.** Telang, S.A. (Acid Deposition Research Program, Calgary (Alberta)). Feb 1987. 131p. (ADRP-B—01-87). NTIS, PC E06/MF A01.

See also PB—88-143441.

The objective of this report is to analyze the present state of knowledge on relationships between acid deposition and surface-water acidification with reference to chemical criteria that have been used to evaluate surface-water acidification. To achieve this objective, the report provides brief background information on precipitation chemistry and the manner by which acidity of precipitation and surface waters is measured. It also provides information on why some waters are sensitive to acidification and others are not. After briefly describing reactions of hydrogen ions in aquatic and terrestrial systems, the report addresses three questions: (1) How do factors of quantity and quality of precipitation and episodic events affect the process of acidification of surface waters. (2) Does surface-water acidification occur by anthropogenic or natural input of hydrogen ions. (3) Do watershed characteristics influence surface-water susceptibility to acidification. The report also includes a section describing acidification studies in North America with particular reference to Alberta, a section discussing acidification effects on aquatic biota, a summary of models that have been used in surface-water acidification studies, and a list of recommendations for studies in Alberta.

22845 **(PB—88-147780/XAB) Reverse osmosis treatment to remove inorganic contaminants from drinking water.** Huxstep, M.R.; Sorg, T.J. (Charlotte Harbor Water Association, Inc., Harbour Heights, FL (USA)). Dec 1987. 61p. NTIS, PC A04/MF A01.

The purpose of the research project was to determine the removal of inorganic contaminants from drinking water using several state-of-the-art reverse osmosis membrane elements. A small 5-KGPD reverse osmosis system was utilized and five different membrane elements were studied individually with the specific inorganic contaminants added to several natural Florida ground waters. Removal data were also collected on naturally occurring substances.

22846 **(PB—88-148754/XAB) Annotated bibliography on wellhead protection programs.** (Environmental Protection Agency, Washington, DC (USA). Office of Ground-Water Protection). Aug 1987. 81p. (EPA—440/6-87/014). NTIS, PC A05/MF A01.

A bibliography referencing 142 documents that contain information on one or more of the six required program elements in the Wellhead Protection program (WHP). The purpose of the document is to provide a mechanism by which state and local officials can use the experience of others to aide in the development of their WHP programs. These references examine the following elements: duties of state and local agencies in wellhead protection programs; determination of WHP areas around supply wells; identification of contaminants in the WHP areas; describe programs of WHP; contingency plans if contamination occurs; and protection of new wells.

22847 **(PB—88-856299/XAB) Eutrophic lakes. January 1978-December 1987 (citations from the Selected Water Resources Abstracts data base). Report for January 1978-December 1987.** (National Technical Information Service, Springfield, VA (USA)). Jan 1988. 141p. NTIS PC N01/MF N01.

Supersedes PB—86-854411.

This bibliography contains citations concerning causes, effects, and various approaches in limiting nutrient loading into eutrophic lakes throughout the world. Nutrient removal treatment and performance is included in another bibliography. Eutrophic lake identification, and ecological and limnological studies of eutrophic lake development and restoration are presented. Included in the citations are discussions of phosphorus and nitrogen concentrations in lakes, and analyses of lake water quality. (This updated bibliography contains 256 citations, 62 of which are new entries to the previous edition.)

22848 **(PB—88-856547/XAB) Heavy metals in drinking water: standards, sources, and effects. January 1977-December 1987 (citations from the Selected Water Resources Abstracts data base). Report for January 1977-December 1987.** (National Technical Information Service, Springfield, VA (USA)). Jan 1988. 77p. NTIS PC N01/MF N01.

Supersedes PB—87-852356.

This bibliography contains citations concerning the public health aspects and documented studies of heavy metal pollutants in drinking water. Topics include human exposure studies and the toxicological effects incurred by ingestion of lead, copper, nickel, mercury, cadmium, manganese, and zinc. Prolonged exposure and quantification factors and effects, federal and state regulations and standards, and laboratory animal studies are discussed. Sources from landfill contamination of groundwater, acid precipitation contributions to groundwater pollution, and corrosion by-products in residential plumbing and public water supply transport systems are examined. (This updated bibliography contains 139 citations, 22 of which are new entries to the previous edition.)

22849 **(PB—88-857016/XAB) Ground water pollution: general studies. December 1984-January 1988 (citations from the NTIS data base). Report for December 1984-January 1988.** (National Technical Information Service, Springfield, VA (USA)). Jan 1988. 162p. NTIS PC N01/MF N01.

Supersedes PB—87-851655.

This bibliography contains citations concerning sources, contaminant transport, and monitoring of pollutants in aquifers. Topics include pollution characterization from landfills and mine drainage, descripuons of study programs undertaken by specific states, and Superfund site studies of contaminated areas. The utilization of mathematical models is also discussed. Studies pertaining specifically to irrigation, and pollution from fertilizers are excluded. (This updated bibliography contains 319 citations, 94 of which are new entries to the previous edition.)

22850 **(PB—88-857156/XAB) Polychlorinated biphenyls in the freshwater environment. January 1977-January 1988 (citations from the Selected Water Resources Abstracts data base). Report for January 1977-January 1988.** (National Technical Information Service, Springfield, VA (USA)). Jan 1988. 129p. NTIS PC N01/MF N01.

Supersedes PB—87-855094.

This bibliography contains citations concerning the occurrence and effects of polychlorinated biphenyls in the freshwater environment. Topics include sources, distribution, and accumulation rates for specific regions, bioaccumulation, pollutant paths and introduction into the food chain, and results of long and short term monitoring of selected areas. Detection methods for PCB accumulation in fish and surficial sediments are also considered. (This updated bibliography contains 239 citations, 19 of which are new entries to the previous edition.)

22851 **The interaction of biological and hydrological phenomena that mediate the qualities of water draining native tallgrass prairie on the Konza Prairie research natural area.** McArthur, J.V.; Gurtz, M.E.; Tate, C.M.; Gilliam, F.S. (Savannah River Ecology Lab., Aiken, SC). pp 478-482 of Perspectives on nonpoint source pollution. Washington, DC; U.S. Environmental Protection Agency (1985). (CONF-8505148—; EPA—440/5-85-001). Contract AC09-76SR00819.

From National conference on perspectives on nonpoint source pollution; Kansas City, MO, USA (19 May 1985).

The quality of water from native landscapes is the baseline against which the impact of pollutants on surface water resources must be evaluated. The King's Creek watershed has been a U.S. Geological Survey benchmark watershed since 1979. Hydrologic, chemical, and biological measurements have been made by ecologists performing long-term ecological research (LTER) in tallgrass prairie. Streamwater chemistry varies seasonally with the amount and movement of ground water and soil water, with changes in prairie vegetation, and in response to changes in surface water discharge. Concentrations of organic carbon, organic and inorganic nitrogen, and phosphorus increase during storm flows. The particulate fractions in transport and in storage in the stream bed and on the flood plain vary seasonally with recent hydrologic history and changes in vegetation.

5203 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 21093, 21102, 21613, 22226, 22227, 22515, 22516, 22517, 22815, 22816, 22819

22852 (INIS-mf—10846, pp 43) **Measurement of radium-222 and its short-living daughters in the districts of Pchelin and Momin Prokhod.** Minev, L.; Kritidis, P.; Uzunov, I.; Teofilov, S.; Uzunov, P. (Sofia Univ., Bulgaria). Nov 1984. (In Bulgarian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

22853 (INIS-mf—10846, pp 73) **Relationship of potassium-40 to the radioactivity of drinking water in Transilvania.** Bayer, M.; Vaida, V. (Institutul de Medicina si Farmacie, Cluj, Romania). Nov 1984. NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

22854 (INIS-mf—11113, pp 81-89) **Rare earths in natural waters and their intercorrelation.** Nevoral, V. (Vyzkumny Ustav Balneologicky, Marianske Lazne, Czechoslovakia). 1986. (In Czech). NTIS (US Sales Only), PC A20/MF A01. Order Number DE88701480/JAW. (CONF-8611221—).

From 23. seminar on new analytical methods in water chemistry - hydrochemistry '86; Bratislava, Czechoslovakia (26 Nov 1986).

The levels were determined spectrophotometrically of rare earth elements in waters from 23 sources including mineral springs, mine waters and the drinking water supply for the town of Marianske Lazne. The overall content of rare earths ranged between 2 x 10/sup -7/ and 3 x 10/sup -5/ g/l. The highest concentrations were recorded for mine water from Ostrava, mineral waters from Marianske Lazne and its surroundings, and mineral waters from Luhacovice. (E.S.). 2 figs., 2 tabs., 11 refs.

22855 **(INIS-mf—11113) Hydrochemistry '86.** Bilikova, A.; Hucko, P.; Lehocky, J.; Stankovic, V. (eds.). (Vyskumny Ustav Vodneho Hospodarstva, Bratislava (Czechoslovakia)). 1986. 472p. (In Czech and Slovak). (CONF-8611221—). NTIS (US Sales Only), PC A20/MF A01. Order Number DE88701480/JAW.

From 23. seminar on new analytical methods in water chemistry - hydrochemistry '86; Bratislava, Czechoslovakia (26 Nov 1986).

34 papers, of which two fall under the INIS Scope, were submitted to the seminar. One of the inputted materials concerned the determination of rare earth traces in mineral, mine and drinking waters, the other discussed the occurrence of high alpha activity in water and the determination of high /sup 222/Rn concentrations in mineral and drinking waters. (E.S.).

22856 (INIS-mf—11113, pp 405-419) **Some experience from monitoring alpha activity of waters.** Krejbichova, Z. (Stavebni Geologie, Prague, Czechoslovakia). 1986. (In Czech). NTIS (US Sales Only), PC A20/MF A01. Order Number DE88701480/JAW. (CONF-8611221—).

From 23. seminar on new analytical methods in water chemistry - hydrochemistry '86; Bratislava, Czechoslovakia (26 Nov 1986).

Mineral, mine and especially drinking water sites with high levels of radium, natural uranium and radon are listed. Measurements were made on mixtures of evaporation residues with scintillator ZnS(Ag); the use of a plastic scintillator was also tried out. The results of determinations of alpha activities, of radium, uranium and radon in waters from different localities are tabulated. The results are also reported of the analysis of some mineral waters and of a study of water in the Liberec district, concerning the levels of radon and /sup 210/Po. A possible radon effect on the determination of gross specific alpha activity is discussed. (E.S.). 3 figs., 2 tabs., 10 refs.

22857 **(NAGRA-NTB—84-36) Surveillance of the North-Eastern Atlantic dumpsite for low-level radioactive waste. The Swiss oceanographic research program PROSPER. Progress report.** Nyffeler, F.; Wyttenbach, A.; Ruch, P.; Jaquet, J.M.; Hanselmann, K. (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Aug 1984. 93p. Nagra, CH-5401 Baden, Switzerland.

This report describes the results of the research undertaken within the CRESP program by the Swiss group PROSPER, for surveillance of the current dumpsite for low-level radioactive waste in the North-Eastern Atlantic. About 100 nephelometric profiles obtained during three cruises in the vicinity of the site provide a sound basis for the description of the benthic nepheloid layer (BNL) structure. Statistical analyses show that the last 1000 m of water above the bottom are influenced by resuspension processes or by lateral advection of particles detached from the surrounding relief. A mapping performed over a large area (200 x 200 km) confirms the accumulation of particles in topographic lows. Geochemi-

cal analysis of suspended matter and surficial sediment was carried out in order to compare their elemental composition, and to determine the classes of particles more likely to be resuspended. The discrepancy between BNL and local sediment composition suggests that advective transport or resuspension of older bottom sediment, exposed following slumping from the hill slopes, could act in addition to the local resuspension of recent sediment.

22858 **(NAGRA-NTB—87-03) Design of a single-borehole hydraulic test programme allowing for interpretation-based errors.** Black, J.H.; Barker, J.A. (British Geological Survey, Keyworth (UK). Fluid Processes Research Group; Hydrogeology Research Group, Wallingford (UK)). (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Jul 1987. 73p. Nagra, CH-5401 Baden, Switzerland.

Hydraulic testing using packers in single boreholes is one of the most important sources of data to safety assessment modelling in connection with the disposal of radioactive waste. It is also one of the most time-consuming and expensive. It is important that the results are as reliable as possible and as accurate as necessary for the use that is made of them. There are many causes of possible error and inaccuracy ranging from poor field practice to inappropriate interpretation procedure. The report examines and attempts to quantify the size of error arising from the accidental use of an inappropriate or inadequate interpretation procedure. In doing so, it can be seen which interpretation procedure or combination of procedures results in least error. Lastly, the report attempts to use the previous conclusions from interpretation to propose forms of field test procedure where interpretation-based errors will be minimised. Hydraulic tests (sometimes known as packer tests) come in three basic forms: slug/pulse, constant flow and constant head. They have different characteristics, some measuring a variable volume of rock (dependent on hydraulic conductivity) and some having a variable duration (dependent on hydraulic conductivity). A combination of different tests in the same interval is seen as desirable. For the purposes of assessing interpretation-based errors, slug and pulse tests are considered together as are constant flow and constant head tests. The same method is used in each case to assess errors. The method assumes that the simplest analysis procedure (cylindrical flow in homogeneous isotropic porous rock) will be used on each set of field data. The error is assessed by calculating synthetic data for alternative configurations (e.g. fissured rock, anisotropic rock, inhomogeneous rock - i.e. skin - etc.) and then analyzing this data using the simplest analysis procedure. 28 refs., 26 figs.

22859 **(PB—88-139977/XAB) Potential toxicity of uranium in water.** Wrenn, M.E.; Durbin, P.W.; Willis, D.L.; Singh, N.P. (Utah Univ., Salt Lake City (USA)). 1987. 11p. NTIS, PC A03/MF A01.

Pub. in Jnl. of American Water Works Association, Vol. 79, 177-184(Apr 87).

The nephrotoxic responses of mammalian species, including humans, to injected, inhaled, ingested, and topically applied uranium compounds have been thoroughly investigated. Because there appear to be unequivocal reports of uranium-induced radiation effects in humans, it is necessary to rely on experimental work with animals and on epidemiological investigations of human populations exposed to radium isotopes to infer human response to the alpha-particle emissions of uranium. Metabolic models have been developed to relate the intake of uranium in water and food to its uptake in the human skeleton and soft tissues. A US Environmental Protection Agency committee has recommended a limit for uranium in drinking water of 100 ug/L to limit effects on the kidney, which includes a substantial safety factor.

22860 **(PB—88-150040/XAB) Silver-110m, cobalt-58, and zinc-65 concentrations in the American oyster, Crassostrea virginica (gmelin), near the Calvert Cliffs Nuclear Power Plant. Research report (Final) 1978-1986.** McLean, R.I.; Summers, J.K.; Rose, K.A.; Demotor, S.L. (Maryland Power Plant Research Program, Annapolis (USA)). Dec 1987. 68p. (PPRP-R—7). NTIS, PC A04/MF A01.

As part of a comprehensive assessment of the radiological impact of the Calvert Cliffs Nuclear Power Plant, the Power Plant Research Program has routinely monitored radionuclide concentrations in oysters. Monitoring involved the measurement of nuclide concentrations in oysters introduced and maintained in trays in the vicinity of the plant discharge, and in a nearby natural population. Only Ag-110m, Co-58, and Zn-65 were consistently detected in oysters. Calculation of relative concentration factors show that oysters clearly bioconcentrate these radionuclides, particularly Ag-110m, but can eliminate large portions quickly if the source of the radionuclides is eliminated.

22861 **Transport of solutes through unsaturated fractured media.** Dykhuizen, R.C. (Sandia National Labs., Albuquerque, NM, USA). *Water Research;* **21**: No. 12, 1531-1539(Dec 1987). Contract AC04-76DP00789.

A numerical model is presented to represent the transport of solutes through a highly fractured, unsaturated porous medium. To accomplish this, the solute is tracked separately in two flow systems, a matrix pore flow system and a fracture network, with interaction terms. Compatible hydraulic equations for such a dual system are also presented to enable solution of the solute transport. The hydraulic equations chosen use the equivalent porous media concept. These equations can also be applied to a saturated medium without modification; however, many of the transport terms will be negligible for such an application.

5205 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 21228, 21229, 21230, 21231, 21232

22862 **(PB—88-856042/XAB) Artificial recharge of aquifers. January 1977-December 1987 (citations from the Selected Water Resources Abstracts data base). Report for January 1977-December 1987.** (National Technical Information Service, Springfield, VA (USA)). Jan 1988. 142p. NTIS PC N01/MF N01.

Supersedes PB—87-852141.

This bibliography contains citations concerning the utilization of artificial recharge methods to improve water availability and water quality. Topics include site studies and evaluation, the use of impounded fresh water and treated waste water, the role of artificial recharge techniques in ground water resource management, individual state programs, contaminant behavior, and the engineering aspects of utilizing spreading ponds and injection wells. Legal and environmental considerations and the use of computer simulations are also treated. (This updated bibliography contains 247 citations, 40 of which are new entries to the previous edition.)

5206 Regulations

REFER ALSO TO CITATION(S) 21703, 22355, 22821, 22822, 22823, 22824, 22825, 22826, 22827, 22828

22863 **(AD-A—187343/9/XAB) Guide to the Department of Defense operation, maintenance, and training-assistance program (OMTAP) for wastewater treatment plant personnel. Technical report, 1985-1987.** (Ciccone (V.J.) and Associates, Inc., Woodbridge, VA (USA)). Jun 1987. 79p. NTIS, PC A05/MF A01.

OMTAP is a Department of Defense program to improve the performance of wastewater-treatment plants located on military installations. The program is divided into three phases, each requiring a site visit by a team of evaluators. The first phase involves a comprehensive evaluation of the treatment process to identify operational and/or design deficiencies. In the second phase, operators and laboratory technicians are trained on procedures recommended to overcome problems identified during the diagnostic phase. The final phase is a follow-on evaluation of plant performance to assess those improvements that have been made since OMTAP was initiated at the plant.

22864 **(PB—88-131495/XAB) State of Alaska coastal management program and final environmental impact statement.** (National Oceanic and Atmospheric Administration, Rockville, MD (USA). Office of Coastal Zone Management). 30 May 1979. 578p. (OCRM—87-23). NTIS, PC A25/MF A01.

It is proposed that the Assistant Administrator for Coastal Zone Management approve the Coastal Management Program application of Alaska pursuant to P.L. 92-583. Approval would allow program administration grants to be awarded to the state and require that federal actions be consistent with the program. The program will enhance governance of the state's coastal land and water areas and uses according to coastal policies and standards implemented by existing state and local authority. The effect of these policies and standards is to condition, restrict or prohibit some uses in parts of the coastal zone, while encouraging development and other uses in other parts.

22865 **(PB—88-131503/XAB) Delaware coastal management program and final environmental impact statement.** (National Oceanic and Atmospheric Administration, Rockville, MD (USA). Office of Coastal Zone Management). Mar 1980. 551p. (OCRM—87-22). NTIS, PC A24/MF A01.

The State of Delaware has submitted its Coastal Zone Management Program to the Office of Coastal Zone Management for approval. Approval would permit implementation of the proposed program, allow program administration grants to be awarded to the state. The impact statement includes a copy of the Program which is a comprehensive management program for land and water use activities. It consists of numerous policies on diverse management issues which are enforced by various state laws. Approval and implementation of the program will enhance governance of the state's coastal land and water areas and uses according to the coastal policies and standards.

22866 **(PB—88-136817/XAB) Class V injection wells: current inventory; effects on ground water; technical recommendations. Executive summary of the report to Congress. Final report.** (Engineering Enterprises, Inc., Norman, OK (USA)). Sep 1987. 29p. NTIS, PC A03/MF A01.

See also PB—88-111596.

The report to Congress summarizes the results of State surveys concerning Class V injection wells as defined by the 1986 Amendments to the Safe Drinking Water Act. The report (1) identifies the categories and corresponding inventories of Class V wells in the United States and its Territories and Possessions, (2) describes primary contamination problems associated with different categories of these wells, and (3) summarizes recommendations for minimum design, construction, installation, and siting requirements that could be applied to protect underground sources of drinking water.

22867 **(PB—88-139928/XAB) Selection criteria for mathematical models used in exposure assessments: surface-water models.** McKeon, T.J.; Segna, J.J. (Environmental Protection Agency, Washington, DC (USA). Office of Health and Environmental Assessment). Jul 1987. 174p. (EPA—600/8-87/042). NTIS, PC A08/MF A01.

Prior to the issuance of the Guidelines for Estimating Exposures in 1986, the U.S. Environmental Protection Agency (EPA) published proposed guidelines in the Federal Register for public review and comment. The purpose of the guideline is to provide a general approach and framework for carrying out human and nonhuman exposure assessments for specific pollutants. As a result of the review process, four areas were identified that required further research. One of these was the area of selection criteria for mathematical models used in exposure assessment. The purpose of this document is to present criteria which provide a means for selecting the most-appropriate mathematical model(s) for conducting an exposure assessment related to surface-water contamination. A concerted effort was made to provide general background information regarding surface-water flow and contaminant transport and to characterize the important assumptions and limitations of existing models. These include a detailed summary matrix and model writeups for ten runoff models, twelve surface-water flow models, and twelve contaminant-transport models that have been used previously by EPA to study surface-water quality problems.

22868 **(PB—88-140298/XAB) National Surface Water Survey, National Stream Survey. Phase 1. Pilot survey, summary of quality-assurance data results.** Drouse, S.K. (Lockheed Engineering and Management Services Co., Inc., Las Vegas, NV (USA)). Dec 1987. 54p. NTIS, PC A04/MF A01.

See also PB—87-188702.

A primary objective of the National Surface Water Survey and, thus, of the National Stream Survey is to ensure that the data collected are scientifically sound and of known quality. An extensive quality-assurance program was established in support of the objective. To evaluate the effectiveness of the quality-assurance program, several types of quality-assurance and quality-control samples were collected and analyzed during a pilot survey that was conducted prior to the initiation of National Stream Survey Phase I field activities. The report presents a statistical analysis of results obtained for field duplicate samples, blank samples, and audit samples used in the pilot survey. The results show that even overall estimated within-batch precision was adequate to meet the analytical data quality objectives established for the National Stream Survey and that detection limit goals were achieved at the contract analytical laboratories. The observed system decision limits and system detection limits, however, must be considered in interpreting the pilot study data and data from future surveys that employ similar sampling, processing, and analytical methods.

22869 **(PB—88-140587/XAB) Water-pollution control: guidelines for project planning and financing. World Bank technical paper.** Palange, R.C.; Zavala, A. (International Bank for Reconstruction and Development, Washington, DC (USA)). 1987. 226p. (WORLD-BANK-TP—73). NTIS MF A01.

Library of Congress catalog card No. 87-27930; Microfiche copies only. Paper copy available from World Bank, 1818 H St., NW, Washington, DC 20433.

This publication provides guidelines to managers, supervisors, and others who are involved with decisions on filling needs for water-pollution-control facilities, but who may be lacking the detailed background in engineering, economics, financial management, or other applicable specialties. Political and economic planning leaders, who must provide the financial resources and overall policies, will also find the document useful in making themselves aware of the financial, technical, legal, economic, and other problems which must be solved in order to protect the water environment.

22870 **(PB—88-148234/XAB) Inventory of non-federally funded marine pollution research, development, and monitoring activities: West Coast region.** Canton, G.M.; Opresko, D.M.; Weaver, R.S. (Oak Ridge National Lab., TN (USA). Biology Div.). Dec 1987. 190p. NTIS, PC A09/MF A01.

See also PB—86-102308.

Knowledge of current marine pollution research and monitoring programs is an important factor in planning and guiding future national efforts to control such pollution. To supplement these reports on Federal activities, NMPPO published a series of reports in 1980 on non-federally funded marine pollution research and monitoring activities in various regions. The following document presents an update of one of these reports. It presents an inventory of the non-federally funded research and monitoring projects for the West Coast region of the United States. It is one in a series of four updates that will collectively provide an updated inventory of non-federally funded projects for all the coastal regions of the United States.

22871 **(PB—88-159942/XAB) Superfund Record of Decision (EPA Region 2): Montgomery Township Housing Development, New Jersey, (first remedial action), September 1987. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 29 Sep 1987. 121p. (EPA/ROD/R—02-87/045). NTIS, PC A06.

The Montgomery Township Housing Development (MTHD) is a 72-acre tract of land located in Somerset County, New Jersey. The housing development consists of 71 home sites. The original potable water source for each home was a private well drawing from the underlying aquifer. In 1978, the Borough of

Rocky Hill, which is located near the site, sampled ground water from the Borough well and found it to be contaminated with trichloroethylene (TCE). Testing continued through 1983, and repeated evidence of TCE contamination prompted the New Jersey Department of Environmental Protection (NJDEP) to sample the MTHD well. Results indicated the presence of TCE and other volatile organics in that and other surrounding wells. In 1981, 20 homes in the MTHD were connected to the Elizabethtown Water Company water mains. To date, 38 residences have hooked up. Due to the similarity of contaminants and the proximity of the MTHD and Rocky Hill Municipal Well Superfund sites, a combined RI/FS is being performed. The ROD focuses only on an alternate water supply for MTHD. The primary contaminant of concern is TCE, with secondary contaminants being other volatile organics.

22872 **(PB—88-159959/XAB) Superfund Record of Decision (EPA Region 2): Haviland Complex, Town of Hyde Park, Dutchess County, New York, (first remedial action), September 1987. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 30 Sep 1987. 55p. (EPA/ROD/R—02-87/046). NTIS, PC A04/MF A01.

The Haviland Complex site consists of a planned development comprising 275 acres in the town of Hyde Park, NY. The development contains an apartment complex, a junior high school, an elementary school, a shopping center and a number of private homes. Beginning in October 1981, a local resident filed a complaint with the Dutchess County Health Department noting that his well water was foaming. Other complaints of water-quality supply problems prompted a sampling program and sanitary survey of the Haviland area. Results of these tests indicated failure in nearby car wash and laundromat septic and sewage systems. In 1982, the laundromat installed a sand filter and a new tile field to handle the laundry effluent. Due to increasing concern over potential groundwater contamination by volatile organic chemicals, the New York State Department of Health (NYDOH) began sampling wells in December 1982. In January 1983, the laundromat was ordered to disconnect the dry-cleaning unit from the recently upgraded sewer-disposal system and dispose of all spent cleaning fluids offsite with a licensed disposal firm.

22873 **(PB—88-159983/XAB) Superfund Record of Decision (EPA Region 5): Rose Township, Demode Road Site, Oakland County, Michigan, (first remedial action), September 1987. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 30 Sep 1987. 175p. (EPA/ROD/R—05-87/052). NTIS, PC A08.

The Rose Township Dump site is located in rural Rose Township, Oakland County, Michigan. The 110-acre site comprises an upland area almost completely surrounded by wetlands, with an abundance of wildlife onsite. From 1966 to 1968 an unknown number of drums containing solvents, paint sludges and PCBs were buried in a 12-acre portion of the site. Bulk wastes were also discharged to the surface or into shallow lagoons or pits in the area. In June 1979, the Michigan Department of Natural Resources (MDNR) tested domestic wells in the area and found low level TCE and PCE contamination. The contamination made it necessary to supply bottled water to residents. Based on 1979 drum-sampling results, funds were appropriated for an immediate removal action, which disposed of over 5000 drums offsite. Further testing between 1980 and 1982 indicated the presence of organic chemical contamination in the ground water. Currently, the primary contaminants of concern affecting the soil and ground water include: VOCs, PAHs, PCBs, organics, and inorganics.

22874 **(PB—88-159991/XAB) Superfund Record of Decision (EPA Region 5): Laskin/Poplar Oil site, Ashtabula, Ohio, (second remedial action), September 1987.** (Environmental Protection Agency, Washington, DC (USA)). 30 Sep 1987. 49p. (EPA/ROD/R—05-87/053). NTIS, PC A03/MF A01.

See also PB—85-213924; Portions of this document are not fully legible.

The Laskin/Poplar Oil site, occupying approximately 9 acres, is located in Ashtabula County, Ohio. Approximately 80 years ago a greenhouse operation began. Boilers were installed approximately 30 years ago to heat the greenhouses. During the 1960's, tanks were installed to hold waste oil to fire the boilers. The oils were not analyzed prior to acceptance and oil containing PCBs and other hazardous constituents were accepted. As the greenhouse business deteriorated, the owner began collecting, reselling, and disposing of waste oils containing PCBs and other hazardous constituents. Several emergency actions were taken after the site was discovered and during critical periods such as mudslides and flooding. Between July and October 1982, a planned removal action removed 302,000 gallons of waste oil, solidified 205,000 gallons of sludge and treated and released 430,000 gallons of contaminated water. An August 1984 Record of Decision addressed the incineration of contaminated water, oil above 50 ppm PCB, and oil below 50 ppm PCB.

53 ENVIRONMENTAL-SOCIAL ASPECTS OF ENERGY TECHNOLOGIES

5301 Social And Economic Studies

22875 **(IIUG/dp—87-4) Technology, everyday life and the environment. An overview of recent sociological research.** Joerges, B. (Wissenschaftszentrum Berlin (Germany, F.R.). Internationales Inst. fuer Umwelt und Gesellschaft). 1987. 44p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752009/JAW.

This paper gives a critical overview of recent sociological work, in German, in the area 'technology in everyday life'. Particular emphasis is given to the problem of an adequate treatment of ecological issues. Substantive and methodological directions future research might take are derived from a confrontation of major conceptual positions.

22876 **(IIUG/dp—87-5) Body technology - an approach to the ecological/sociological analysis of body technisation.** Joerges, B.; Wessels, H. (Wissenschaftszentrum Berlin (Germany, F.R.). Internationales Inst. fuer Umwelt und Gesellschaft). 1987. 65p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88752010/JAW.

Although nutritional, health and other body related arguments are prominent in ecological and environmental policy debates, social science environmental research has not dealt systematically with the development of 'social body relations' and their significance in terms of ecological problems. The paper focuses on the phenomena of a progressive 'technisation' of everyday life 'body mangement', and proposes an analytical framework for empirical studies.

5302 Assessment Of Energy Technologies

REFER ALSO TO CITATION(S) 22864, 22865

22877 **(UBA-FB—85-077/1-2) Environmental balancing statement - analysis and explanation of current knowledge of the ecologic requirements regarding ecologic and economic balancing of environmental impacts. Vol. 1 and 2.** Bechmann, A.; Hofmeister, S.; Schultz, S. (Umweltbundesamt, Berlin (Germany, F.R.)). Aug 1985. 272p. (In German). Umweltbundesamt, Berlin, Germany, F.R.

Due to the consideration that many of the currently problematic types of environmental impacts are also caused by industrial processes, the discussion on preventive environmental planning concepts has also become relevant to that area. Research was made on the state of the scientific discussion (based on current literature). Special reference was made to practical experience (based on the information of experts). As a result the economic-ecological balancing methods and conceptions found in course of the study have been displayed and analyzed in respect to their scope of applicability, their methods and to their potential as an aid to entre-preneurial planning. On this basis concrete statements could be made in perspective about the suitability of material-energetic balancing models for environmental planning. With 164 refs., 3 tabs., 6 figs..

55 BIOMEDICAL SCIENCES, BASIC STUDIES

REFER ALSO TO CITATION(S) 21203

5501 Behavioral Biology

REFER ALSO TO CITATION(S) 21881

22878 (DOE/ER/60493—1-Vol.3, pp 399-403) **Thermal response of wool clothing during humidity transients.** de Dear, R.J.; Tanabe, S.; Knudsen, H.N.; Pejtersen, J.H.; Mackeprang, J.; Fanger, P.O. (Technical Univ. of Denmark, Lyngby). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Contemporary thermal comfort models and standards based on steady-state assumptions ignore fiber type and moisture content of clothing ensembles. However, during humidity transients, natural fibers with a hygroscopic character such as wool undergo considerable changes of moisture content (regain) which are accompanied by significant heat exchanges. The current study reports on these transient thermal processes in a 0.6 clo wool ensemble worn by a thermal manikin during humidity step-changes from 20 to 80% RH and vice versa.

5502 Biochemistry

REFER ALSO TO CITATION(S) 21133, 21265, 22157, 22199, 22535, 22893, 23072, 23101, 23108

22879 (DOE/ER/60281—3) **[Studies of molecular biology: Final report].** (Rochester Univ., NY (USA). Medical Center). 1988. Contract FG02-85ER60281. 24p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005906/JAW.

This report is the annual summary for the Studies on Molecular Biology Program of the Biophysics Department of the University of Rochester, Medical Center. Brief summaries of five studies are provided. Each individual study was also abstracted and indexed for the Energy Data Base. (DT)

22880 (DOE/ER/60281—3, pp vp, Paper 2) **Performance report, January 1988.** Prakash, L. 1988. NTIS, PC A03/MF A01. Order Number DE88005906/JAW.

In [Studies of molecular biology: Final report].

Although excision repair occurs in most organisms, the detailed mechanism has not been elucidated in any eucaryote. We previously had identified 10 genes in S. cerevisiae required for excision repair of uv induced pyrimidine dimers and other bulky lesions from DNA: RAD1, RAD2, RAD3, RAD4, RAD10, MMS19, RAD7, RAD14, RAD16, and RAD23. Mutants in the first 6 genes are highly defective in the incision step, whereas mutants of the remaining 4 genes show various degrees of incision defectiveness. During the past three years of this grant, we have focused only on the RAD3, RAD10, RAD1, and RAD2 genes and their encoded proteins which summarize our most salient results. 5 refs.

22881 (DOE/ER/60281—3, pp vp, Paper 3) **Mutation and structure-function relationships of cytochrome c: Progress report, January 1988.** Sherman, F. 1988. NTIS, PC A03/MF A01. Order Number DE88005906/JAW.

In [Studies of molecular biology: Final report].

Iso-1-cytochrome c and iso-2-cytochrome c from the yeast Saccharomyces cerevisiae are two of the few proteins of known primary structure from a microorganism which is particularly suitable for experimental genetic studies and for manipulation by recombinant DNA procedures. This iso-cytochrome c system is being employed for investigating numerous problems in molecular biology and genetics, including the following: DNA sequencing of mutations induced by a variety of physical and chemical agents including a number of carcinogens; DNA sequencing of unusual mutations that occur by multiple base-pair changes; and DNA sequencing of missense mutations and structure-function relationships of iso-1-cytochrome c. 3 refs.

22882 (DOE/ER/60281—3, pp vp, Paper 4) **Performance report, January 1988.** Sobell, H. 1988. NTIS, PC A03/MF A01. Order Number DE88005906/JAW.

In [Studies of molecular biology: Final report].

We have synthesized a large number of defined sequence oligonucleotides and have searched for crystalline complexes containing these oligonucleotides and a variety of intercalators. Most attempts to form crystalline complexes fail. We obtained beautiful single crystals of the dodecamer d(GAGCTATAGCTC), along with its complex with actinomycin D. The crystals measure 0.10 x 0.10 x 0.04 mm. We are attempting to grow these to approximately 0.5 x 0.5 x 0.2 mm to obtain detailed diffraction out to high resolution. We are now in the process of a major effort to understand the detailed stereochemistry of actinomycin D binding to DNA. This will be achieved, once the complete three-dimensional structure of this actinomycin D: d(GAGCTATAGCTC) crystalline complex is known. We are therefore striving to solve the structure of this complex.

22883 (DOE/ER/60281—3, pp vp, Paper 5) **Study of structure-function relationships in proteins: Techniques and applications to cytochrome c: Comprehensive report of overall activities for the period January 1, 1985-October 31, 1987.** Goldstein, D.A.; Rackovsky, S.R. 1988. NTIS, PC A03/MF A01. Order Number DE88005906/JAW.

In [Studies of molecular biology: Final report].

Two related studies on protein structure are outlined. One involves the extension and refinement of the differential geometry (DG) based approach introduced by Rackovsky and Scheraga, while the other involved the use of DG to develop a detailed understanding of the structure-function relationships involved in a series of mutations obtained from yeast iso-1-cytochrome c. These mutations involved situations in which changes in one amino acid residue were partially or fully reversed by other changes occurring at a different site. 3 refs., 8 figs., 1 tab.

22884 (INIS-mf—10846, pp 33) **EPR-spectroscopy of slight diffusion intermolecular interactions in complex organic and biological structures and possible applications in pharmacology.** Komar', I.N. (Khar'kovskij Gosudarstvennyj Univ., Ukrainian SSR). Nov 1984. (In Bulgarian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

22885 (LA-UR—88-266) **Chromatin structural changes precede replication in initiated replicons during inhibition of DNA elongation.** D'Anna, J.A.; Grady, D.L.; Tobey, R.A. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 6p. (CONF-880157—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005395/JAW.

From Symposium on molecular and cellular biology; Taos, NM, USA (24 Jan 1988).

Partial inhibition of replicative DNA synthesis by hydroxyurea or other agents produces changes in the composition and structure of bulk chromatin. We have begun to investigate the structural changes in specific regions of the genome using synchronized cells and cloned genomic probes. Current results indicate changes in chromatin structure occur preferentially in initiated replicons and can precede the replication fork during inhibition of DNA elongation. 4 refs., 2 figs.

22886 (LBL—24384) **Biophysical applications of solid state and tritium NMR.** Un, Sun. (Lawrence Berkeley Lab., CA (USA)). Oct 1987. Contract AC03-76SF00098. 193p. NTIS, PC A09/MF A01; 1; GPO Dep. Order Number DE88005328/JAW.

Novel applications of Magic Angle Sample Spinning (MASS) and Tritium (^{3}H) NMR to the study of mammalian tissue

and in vivo metabolism, respectively, are described. The solid state ^{31}P MASS NMR spectra of sodium, magnesium, and calcium complexes of adenosine triphosphate (ATP) were recorded. These spectra indicate that the terminal phosphate group of the sodium complex is protonated in contrast to the unprotonated divalent complexes. The chemical shift tensors of a large variety of phosphates and phosphate esters were measured. The magnitude of the σ_{33}, the low field, elements of the ^{31}P chemical shift tensors in these phosphates were linearly related to the longest P-O bonds and the σ_{11}, the high field, elements to the shortest bonds. Similar relationships were found when these tensor elements were plotted against bond angles. The implications of these observations are discussed in the context of phosphorus-oxygen d-p π bonding interactions. ^{31}P and ^{1}H MASS NMR were applied to the study of lyophilized rat tissue. The ^{31}P spectra exhibit resonances from phospholipids, DNA, ATP and NAD. The MASS results were compared to chemical analysis data obtained by others and to calculated spectra based on MASS data of model compounds. The ^{1}H MASS spectra of these tissue samples exhibited lines with widths less than 40 Hz, and were assigned to phospholipid protons. The intensity distribution of the ^{1}H spectra supported this assignment. Motionally narrowed ^{31}P and ^{1}H resonances suggest that the phospholipids undergo varying degrees of motion with correlation times ranging from 0.5 ns to 2 μs. The degree of hydration of the DNA was also established. 100 refs.

22887 **Characterization of two dissimilatory sulfite reductases (desulforubidin and desulfoviridin) from the sulfate-reducing bacteria. Moessbauer and EPR studies.** Moura, I.; LeGall, J.; Lino, A.R.; Peck, H.D. Jr.; Fauque, G.; Xavier, A.V.; DerVartanian, D.V.; Moura, J.J.G.; Huynh, B.H. (Emory Univ., Atlanta, GA). *Journal of the American Chemical Society;* **110**: No. 4, 1075-1082(17 Feb 1988). Contract AS09-79ER10499.

In this paper, the authors report a detailed Moessbauer investigation of two different sulfite reductases, namely, desulforubidin from D. baculatus and desulfoviridin from D. gigas. In order to better characterize the prosthetic groups, they have also studied the EPR spectra and determined the iron and heme contents of the ^{57}Fe-enriched enzymes. They found that desulforubidin contains exchange-coupled siroheme-[4Fe-4S] units which are similar to those found in the hemoprotein subunit of E. coli sulfite reductase. To their surprise, they discovered that the majority of the purified desulfoviridin contains demetalized sirohydrochlorin, with only a minor portion of the sample containing siroheme. The siroheme in desulfoviridin was also found to be coupled with a [4Fe-4S] cluster.

22888 **Abscisic acid biosynthesis in leaves and roots of Xanthium strumarium.** Creelman, R.A.; Gage, D.A.; Stults, J.T.; Zeevaart, J.A.D. (Michigan State Univ., East Lansing). *Plant Physiology;* **85**: No. 3, 726-732(Nov 1987). Contract AC02-76ER01338.

Research on the biosynthesis of abscisic acid (ABA) has focused primarily on two pathways: (a) the direct pathway from farnesyl pyrophosphate, and (b) the indirect pathway involving a carotenoid precursor. The authors have investigated which biosynthetic pathway is operating in turgid and stressed Xanthium leaves, and in stressed Xanthium roots using long-term incubations in $^{18}O_2$. It was found that in stressed leaves three atoms of ^{18}O from $^{18}O_2$ are incorporated into the ABA molecule, and that the amount of ^{18}O incorporated increases with time. One ^{18}O atom is incorporated rapidly into the carboxyl group of ABA, whereas the other two atoms are very slowly incorporated into the ring oxygens. The fourth oxygen atom in the carboxyl group of ABA is derived from water. ABA from stressed roots of Xanthium incubated in $^{18}O_2$ shows a labeling pattern similar to that of ABA in stressed leaves, but with incorporation of more ^{18}O into the tertiary hydroxyl group at C-1′ after 6 and 12 hours than found in ABA from stressed leaves. It is proposed that the precursors to stress-induced ABA are xanthophylls, and that a xanthophyll lacking an oxygen function at C-6 plays a crucial role in ABA biosynthesis in Xanthium roots. In turgid Xanthium leaves, ^{18}O is incorporated into ABA to a much lesser extent that it is in stressed leaves, whereas exogenously applied ^{14}C-ABA is completely catabolized within 48 hours. This suggests that ABA in turgid leaves is either (a) made via a biosynthetic pathway which is different from the one in stressed leaves, or (b) has a half-life on the order of days as compared with a half-life of 15.5 hours in water-stressed Xanthium leaves. Phaseic acid showed a labeling pattern similar to that of ABA, but with an additional ^{18}O incorporated during 8′-hydroxylation of ABA to phaseic acid.

22889 **Phosphorylation of photosystem II components, CP43 apoprotein, D1, D2, and 10 to 11 kilodalton protein in chloroplast thylakoids of higher plants.** Ikeuchi, M.; Plumley, F.G.; Inoue, Y.; Schmidt, G.W. (Institute of Physical and Chemical Research (RIKEN), Saitama, Japan). *Plant Physiology;* **85**: No. 3, 638-642(Nov 1987). Contract FG09-84ER13188.

Phosphorylated thylakoid proteins of spinach (Spinacia oleracea L.) and pea (Pisum sativum L.) were solubilized, fractionated by sucrose density gradient centrifugation, and analyzed by gel electrophoresis and crossed immunoelectrophoresis to identify the phosphoproteins. It was found that in addition to intense phosphorylation of light-harvesting chlorophyll complex II, four photosystem II components, CP43 apoprotein, D1, D2, and a 10 to 11 kilodalton protein, are substantially phosphorylated in the light. Furthermore, the CP43 apoprotein, D1 and D2 can be resolved into two electrophoretic subspecies, only one of which is phosphorylated. This indicates that only a fraction of the PSII polypeptides is phosphorylated. Finally, analysis of detergent procedures suggests that the 10 to 11 kilodalton phosphoprotein is a peripheral component of the O_2-evolving PSII reaction center complex.

22890 **Acetylene is an active-site-directed, slow-binding, reversible inhibitor of Azotobacter vinelandii hydrogenase.** Hyman, M.R.; Arp, D.J. (Univ. of California, Riverside). *Biochemistry;* **26**: No. 20, 6447-6454(6 Oct 1987). Contract FG03-84ER13257.

The inhibition of purified and membrane-bound hydrogenase from Azotobacter vinelandii by dihydrogen-free acetylene was investigated. The inhibition was a time-dependent process which exhibited first-order kinetics. Both H_2 and CO protected against the inhibition by acetylene. K/sub protect(app)/ values of 0.41 and 24 μM were derived for these gases, respectively. Both H_2-oxidizing activity and the tritium exchange capacity of the purified enzyme were inhibited at the same rate by acetylene. Removal of acetylene reversed the inhibition for both the purified and the membrane-associated form of the enzyme. The purified hydrogenases from both Rhizobium japonicum and Alcaligenes eutrophus H16 were also inhibited by acetylene in a time-dependent fashion. These findings suggest that acetylene is an active-site-directed, slow-binding, reversible inhibitor of some membrane-bound hydrogenases from aerobic bacteria.

22891 **Protein kinase that phosphorylates light-harvesting complex is autophosphorylated and is associated with photosystem II.** Coughlan, S.J.; Hind, G. (Brookhaven National Lab., Upton, NY). *Biochemistry;* **26**: No. 20, 6515-6521(6 Oct 1987).

Thylakoid membranes were phosphorylated with [γ-^{32}P]ATP and extracted with octyl glucoside and cholate. Among the radiolabeled phosphoproteins in the extract was a previously characterized protein kinase of 64-kDa apparent mass. The ability of this enzyme to undergo autophosphorylation in situ was used to monitor its distribution in the membrane. Fractionation studies showed that the kinase is confined to granal regions of the thylakoid, where it appears to be associated with the light-harvesting chlorophyll-protein complex of photosystem II. The kinetics of kinase autophosphorylation were investigated both in situ and in extracted, purified enzyme. In the membrane, autophosphorylation saturated within 20-30 min and was reversed with a half-time of 7-8 min upon removal of ATP or oxidative inactivation of the kinase; the accompanying dephosphorylation of light-harvesting complex was slower and kinetically complex. Fluoride (10 mM) inhibited these dephosphorylations. Autophosphorylation of the isolated kinase was independent of enzyme concentration, indicative of an intramolecular mechanism. A maximum of one serine residue per mole of kinase was esterified. Autophosphorylation was more rapid in the presence of histone IIIs, an exogenous substrate. Dephosphorylation of the isolated enzyme was not observed.

22892 Construction of an obligate photoheterotrophic mutant of the cyanobacterium Synechocystis 6803: inactivation of the psbA gene family. Jansson, C.; Debus, R.J.; Osiewacz, H.D.; Gurevitz, M.; McIntosh, L. (Michigan State Univ., East Lansing). *Plant Physiology;* **85**: No. 2, 1021-1025(Oct 1987). Contract AC02-76ER01338.

psbA in Synechocystis 6803 was found to belong to a small multigene family with three copies. The psbA gene family was inactivated in vitro by insertion of bacterial drug resistance markers. Inactivation of all three genes resulted in a transformant that is unable to grow photosynthetically but can be cultured photoheterotrophically. This mutant lacks oxygen evolving capacity but retains photosystem I activity. Room temperature measurements of chlorophyll a fluorescence induction demonstrated that the transformant exhibits a high fluorescence yield with little or no variable fluorescence. Immunoblot analyses showed complete loss of the psbA gene product (the DI polypeptide) from thylakoid membranes in the transformant. However, the extrinsic 33 kilodalton polypeptide of the water-splitting complex of photosystem II, is still present. The results indicate that assembly of a partial photosystem II complex may occur even in the absence of the intrinsic D1 polypeptide, a protein implicated as a crucial component of the photosystem II reaction center.

5503 Cytology

REFER ALSO TO CITATION(S) 22904, 22976

5504 Genetics

REFER ALSO TO CITATION(S) 21186, 22880, 22960, 22962, 22966, 22971, 23111

22893 (CONF-8709214—Absts.) Biotechnology and the human genome: Innovations and impacts: Science writers workshop. (USDOE Office of Energy Research, Washington, DC. Office of Health and Environmental Research). 1987. Contract AC02-76CH00016. 88p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88004606/JAW.

From Workshop on biotechnology and the human genome: innovations and impacts; Upton, NY, USA (14 Sep 1987).

The Department of Energy's human genome project is one of several major new departmental initiatives that will strengthen the Nation's economic and technological competitiveness. It will provide the computational, engineering and biological capabilities needed to reduce the cost and accelerate the analysis of DNA, the basic genetic material. Knowledge of the entire human genetic map and the genomic sequence will allow investigators to more rapidly and effectively identify genes involved in genetic diseases, individual variabilities including radiation sensitivities, and physiological processes, as well as to make unprecedented inroads into evolutionary relationships. DOE-sponsored investigators in national laboratories, universities, and industry are constructing physical maps of human chromosomes made up of linearly ordered fragments of DNA, developing new techniques for use in determining the chemical sequence of the genetic code, and improving data acquisition, storage and analysis capabilities using the computer resources at Los Alamos. Development of these and other technologies in the fields of biology, chemistry, physics, instrumentation, automation and computing will place the United States at the forefront of the biotechnology of the 21st century. The workshop has been organized to bring together many of the leaders working in scientific disciplines that are either integral parts of the genome project or that represent important ancillary considerations. The aim is to provide a forum in which science writers, reporters and other interested individuals can gain a firsthand knowledge about the scope and direction of the human genome project and its supportive technologies.

22894 (DOE/CH/10093—6, pp 14-15) **Breeding Alnus for intensive culture of biomass for energy.** Hall, R.B. (Iowa State Univ., Ames). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

Alnus has been identified as a leading species for the intensive culture of biomass because of its rapid growth and symbiotic nitrogen-fixing capabilities. To date there has been relatively little genetics work with the genus. A genetics improvement program for Alnus will benefit the continuing development of the genus for woody biomass production. The top 1% of trees in an existing provenance test of Alnus glutinosa in northern Wisconsin, central Iowa, and southern Illinois are being used as the parents in a breeding and clonal propagation program. Trees have been selected for biomass production, climatic adaptability, and resistance to Phomopsis canker and the European leafminer (Fenusa dohrnii). Hybrid vigor is being sought by utilizing inter-provenance and inter-species crosses. Progeny testing will be conducted across a range of environments. As this project progresses, it will make available improved planting stocks to other researchers and to production programs. The status of the field tests is described.

22895 (DOE/CH/10093—6, pp 18-19) **Maximizing woody-biomass production through genetic selection, hybridization, and intensive culture: Phase II.** Hanover, J.W. (Michigan State Univ., East Lansing). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

Woody crops cultured under short rotations offer opportunities for utilizing large acreages of land in north temperate climates for maximum fiber production. Research on the genetics and silviculture of short-rotation species is necessary to develop such production systems with optimal energy inputs. The approach is to select superior trees of black locust, ailanthus, silver maple, and paper birch species; conduct breeding work and progeny testing to identify superior families; test spacing, herbicides, and other management techniques; and begin establishing large-scale biomass plantations, in cooperation with private industries, by integrating the above materials and techniques. Species screening work (completed) has shown several species to be superior for biomass production. Genetic variability in silver maple and white birch has been assessed and summarized. An extensive test of about 400 half-sib families of black locust is under way, and first-year performance is currently being summarized. Cultural tests of planting methods and weed control techniques have been conducted and summarized. Vegetative propagation and crossing techniques have also been investigated for black locust.

22896 (DOE/CH/10093—6, pp 25) **Evaluate Populus selections for fuel wood (US-Indo).** Tauer, C.G. (Oklahoma State Univ., Stillwater). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

The research and development work performed under this agreement is a part of the Indo-US Poplar Studies. The objective is to test a wide range of representatives of the Populus genus to identify genotypes adapted to US sites and to increase the germplasm collection of Populus to broaden the genetic base for traditional and biotechnological genetic methodology. Cuttings of 166 clones of Populus selections from ten cooperators were planted in a cutting bed near Idabel, Oklahoma. Survival after one year ranged from 0% (19 clones) to 100% (27 clones), about what should be expected for such a diverse collection of material. Cooperators have been contacted for replacement materials. A field test site has been located and cleared for planting.

22897 (DOE/CH/10093—6, pp 28) **Tissue culture of elite biotypes of Atriplex canescens as a short rotation woody biomass crop.** McKell, C.M. (Plant Resources Institute/NPI, Salt Lake City, UT). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

The objective of this project is to develop methodologies for tissue culture propagation and in vitro genetic improvement of Atriplex canescens and to make these improved plants available to other researchers for further testing. The authors has collected elite Atriplex canescens biotypes and established these both in the greenhouse and in tissue culture. A system for shoot propagation has

been worked out. Levels of triterpenoid saponins in vegetative tissue of some biotypes has been established. Screening for salt tolerance was begun using callus, microshoots, and whole plants.

22898 (DOE/CH/10093—6, pp 31-32) **Production of woody biofuels from mesquite (Prosopis spp.).** Felker, P. (Texas A & I Univ., Kingsville). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

Various Prosopis (mesquite) species now grow on 30 million hectares in the southwestern US on land that has low economic returns ($5 to $7/net ha-yr). The high solar radiation and long growing season provide high biomass productivity when combined with good water conservation practices. Prosopis is well adapted to this resource since it fixes nitrogen and is very heat tolerant. Promising clones identified in southern California field trials for biomass production under heat/drought stress are being examined for biomass production at two sites differing substantially in their annual rainfall. A major effort is being made to explain differences in productivity of clonal material in terms of climatic and soil factors. Tissue culture research and rooting of cutting research are being conducted for clonal propagation. Second-year productivity of clones at the Kingsville, TX site has been very high (3 Mg/ha first year and 14 Mg/ha second year) while productivity of the more arid site has been much lower (4.8 Mg/ha standing biomass at year 3). Foliage samples of the same clones have been analyzed for 10 elements five times throughout the growing season at both sites. Copper concentrations were much lower on the more arid site, but stepwise regressions between productivity and growth indicate that Ca, Mg, and Fe foliage concentrations were more highly correlated with growth. Long-term research (7-year) on rooting of Prosopis cuttings has finally yielded commercially acceptable results, and a commercial nursery is being developed to use this technology and fast-growing clones for ornamentals in arid areas. Basic research in tissue culture propagation of Prosopis has identified fundamentally different nutrient requirements for Prosopis than for other hardwoods.

22899 (DOE/CH/10093—6, pp 33-35) **Increasing yields of Populus energy plantations.** Hansen, E.A. (Forest Service, St. Paul, MN). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW. Contract AI05-80OR20763.

In Biofuels and municipal waste technology research program summary: FY 1986.

The objective of this project is to improve energy yields through physiology research, breeding and selection, midrotation cultural treatments, and improving selected critical plant traits with biotechnology. Studies on fertilization and irrigation of plantations up to 5 years old have been completed, and results are being summarized. Biomass yield-rotation-tree spacing studies are about two-thirds completed with an estimated 4 years remaining. A study on the nutrient content of 15 clones is being completed this year. Ecophysiological model construction and verification have been completed. Parental breeding populations of each species have been assembled, vegetatively propagated to remove C effects, and established in field tests. P deltoides female parents have been selected for breeding trials. Opportunistic crosses with seven P. maximowiczii select male parents produced 1500 new hybrids in 1986. Five hybrid poplar species are in active shoot regeneration culture and are the explant materials for in vitro selection for herbicide tolerance. Plantlets, possibly having somaclonal variation, have been produced in vitro in the presence of toxic concentrations of both herbicides. 22 references.

22900 (DOE/CH/10093—6, pp 36-38) **Increasing the productivity of alder and cottonwood plantations in the Pacific Northwest.** DeBell, D.S. (Forest Service, Portland, OR). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW. Contract AI05-81OR20914.

In Biofuels and municipal waste technology research program summary: FY 1986.

The objectives of this project are: (1) to determine response of Alnus and Populus to initial spacing, nutrient applications, and irrigation; (2) to identify physiological traits or conditions that are closely related to stand productivity and can be manipulated by genetic selection or cultural practices; (3) to examine genetic variability of and develop tree improvement programs for Alnus rubra; (4) to develop methods for vegetative propagation of Alnus rubra; and (5) to assess relative suitability of land for short-rotation red alder plantations. Three spacing trials have completed their 1-, 5-, or 12-year growing seasons. The latter trial was established without fertilizer or any post-planting vegetation control; the relationships of planting density to mortality, tree growth, and biomass production per hectare have been fairly well defined for such extensive management. Earlier fertilizer studies have indicated that inadequate N is likely to restrict growth of cottonwood plantations, and low P may limit productivity of alder plantings. Tests established this year have created a range of nutritional environments, in irrigated and nonirrigated plots, for two genotypes of each genera. The studies of natural genetic variation in red alder are now 17, 8, 5, and 1 year(s) old. All indicate substantial variation and suggest large gains in productivity through selection and propagation of superior trees from certain coastal sites. Their work on clonal propagation shows that stem and branch cuttings of red alder can be easily rooted, but efficient methods for conditioning the plantlets for outplanting remain to be developed. A field guide for assessing site quality and new curves for height growth and site index estimation (base age 20 years) has been completed. 13 references.

22901 (DOE/CH/10093—6, pp 43-44) **Evaluation and genetic improvement of black cottonwood for short-rotation coppice culture.** Stettler, R.F. (Univ. of Washington, Seattle). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

Harvest data of a 4-year-old trial at 1.2 m x 1.2 m spacing, irrigated and fertilized, gave mean plot yields ranging from 5.1 to 22.8 ODT/ha-yr for black cottonwood, 15.4 to 27.7 ODT/ha-yr for hybrids. Resprouting in the fifth year was satisfactory, and enough clones proved to be good performers under both regimes. After 3 years of growth, field trials 3a (Washington) and 3b (Oregon), involving the best 687 clones, showed consistently superior performances of the new hybrid material in volume growth, leaf retention, and rust resistance. The same trends were observed in smaller field tests conducted by cooperating industries/agencies. Hybrid superiority was also documented in field trial 3c in northern Washington (2-year data) and 3d in northern Oregon (1-year data). An expanded breeding program has broadened the genetic diversity among the F_1 hybrids and included germ plasm of P. maximowiczii in three-way hybrids. A major integrative physiology study was launched with a newly established field plantation of parental and hybrid clones. Phenology, leaf inclination, growth, productivity, net photosynthesis, and carbon allocation were documented for the first growing season. A production nursery operated in cooperation with Association of Soil Conservation Districts, SCS, and Washington State Department of Natural Resources is propagating cutting materials from selected hybrids for broader testing in the Northwest.

22902 (DOE/CH/10093—6, pp 45) **Indo-US poplar studies.** Stettler, R.F. (Univ. of Washington, Seattle). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

Little information exists on the natural variation of Populus trichocarpa in relation to the pronounced moisture gradient across the Cascade Range. This information would be useful in the selection of clonal materials for India. The project involves the study of 140 clones sampled from rivers east and west of the Cascades and grown in two replicate plantations on both sides of the Cascade Range. One hundred forty clones of black cottonwood were collected from four river drainages, grown in a stoolbed for one growing season and then outplanted in two replicate plantations: one in Puyallup, Washington; the other in Wenatchee, Washington. Height and diameter data from the stoolbed showed a systematic decrease from western to eastern clone sources, a higher incidence of Melampsora occidentalis rust in eastern clones but lower midday photosynthetic rates in western clones. Similar trends were evident in the two test plantations. Survival was 85% in Puyallup, 65% in Wenatchee; the corresponding figures for height growth were 190

cm and 110 cm; for diameter growth, 165 mm and 85 mm; and for leaf area per tree, 155 cm^2 and 40 cm^2, respectively.

22903 (DOE/CH/10093—6, pp 55-57) **In vitro plant regeneration of sorghum.** Kresovich, S. (Texas A & M Research Foundation, College Station). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

The overall objective of this study is to identify fundamental biological information and modify processes responsible for efficient in vitro plant regeneration of sorghum, Sorghum bicolor (L.) Moench. Supporting objectives of this study include the following: (1) compare and contrast similarities and differences in responsive and recalcitrant genotypes of sorghum based on biochemical, cytological, histological, morphological, and genetic analyses; (2) based on the differences identified in subobjective 1, identify processes and effect changes that may improve the efficiency of plant regeneration of recalcitrant genotypes; and (3) if success is achieved in subobjective 2, additional agronomically important, albeit recalcitrant, genotypes will be introduced in an attempt to improve their frequency of regeneration. Establishment of callus cultures of six genotypes of sorghum allows cytological, histological, and biochemical analyses. Explant sources include leaf tissues, immature and mature embryos, immature inflorescences, rachis sections, and nodal tissues. These are cultured on media containing different chemical components. Differences within treatments and between genotypes are determined based on cytological, histological, and biochemical analyses.

22904 **Linkage conservation and oncogene mapping in the Chinese hamster.** Stallings, R.L.; Munk, A.C.; Longmire, J.L.; Jett, J.H.; Crawford, B.D. (Life Science Div., Los Alamos Nat'l. Lab., Los Alamos, NM 87545). pp 238-239 of Advances in gene technology: Human genetic disorders. Scott, W.A.; Ahmad, F.; Black, S.; Schultz, J.; Whelan, W.J. New York, NY; Cambridge University Press (1984). (CONF-8401122—).

From Advances in gene technology: human genetic disorders; Miami, FL, USA (16 Jan 1984).

A panel of Chinese hamster x mouse somatic cell hybrid clones which have segregated hamster chromosomes has been used to assign 31 drug-resistance and enzyme gene loci to chromosomes in the Chinese hamster (Cricetulus griseus). This clone panel, in conjunction with flow cytometric techniques, is being used to assign oncogene loci to chromosomes in this species. A summary of current mapping assignments and a description of the authors' approach to oncogene mapping are described here. These studies should provide information on the evolutionary origin and rearrangement of oncogene loci in several mammalian species, and may offer insights regarding the significance of specific chromosomal alterations which are observed during the multistep neoplastic progression of cells derived from the Chinese hamster.

5505 Metabolism

REFER ALSO TO CITATION(S) 22812, 22973, 22974

5506 Medicine

REFER ALSO TO CITATION(S) 21107, 22440, 23101, 23101, 23106, 23123, 23713

22905 (DOE/ER/60519—T1) **New imaging systems in nuclear medicine: Technical progress report.** Brownell, G.L. (Massachusetts General Hospital, Boston (USA). Physics Research Lab.). [1987]. Contract FG02-87ER60519. 35p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004805/JAW.

The Physics Research Laboratory of the Massachusetts General Hospital has been in the forefront of the field of nuclear medicine instrumentation for the past thirty-six years, particularly in the area of instrumentation dealing with the application of short-lived cyclotron-produced isotopes. We continue to improve the operation of PCR-I, a single ring demonstration system employing analog coding to achieve high resolution (4 to 5 mm), high sensitivity (45,000 c/s/ Ci/cc) and high sampling frequency without interpolative motion. This device is designed for brain imaging in humans and for animal studies. An intensive program of software development was carried out concurrently with hardware development and led to the PL/S computer system used for PCI and PCII. Subsequently, more powerful systems were developed using a Data General Eclipse computer and, more recently, an IBM PC/AT computer with array processor. Our laboratory is now engaged in a design study of a cylindrical positron tomograph (PCR-II). 136 refs., 6 figs., 1 tab.

22906 (INIS-BR—585, pp 18) **Radiologic evaluation of retinoblastoma.** Tonumura, E.T.; Matushita, J.P.K.; Pinel, M.I.S. 1985. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780098/JAW. (CONF-8509378—).

From 20. Brazilian Congress of Radiology; 4. Brazilian Congress of Ultrasonography; 2. Latin American Congress of Ultrasonography; 1. Brazilian Congress of Physicists in Medicine; Belo Horizonte, Brazil (15 Sep 1985).

22907 (INIS-BR—925) **Aspects of biliary canal for diagnosis of cholestase. A radiologic-endoscope study.** Ginelli, A.L.C.; Barreto, M.M.; Coelho, J.F.E. (Sociedade Brasileira de Radiologia, Sao Paulo). 1986. 1p. (In Portuguese). (CONF-8611223—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701466/JAW.

From 18. meeting on radiology from Rio de Janeiro; 10. meeting on radiology residents from Rio de Janeiro; Rio de Janeiro, Brazil (19 Nov 1986).

22908 (INIS-BR—927) **Radiological demonstration (TC) of anterograda degeneration (Walleriana) of spinal-cortic sheaf.** Pinheiro, R.S.A. (Sociedade Brasileira de Radiologia, Sao Paulo). 1986. 1p. (In Portuguese). (CONF-8611223—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701467/JAW.

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22909 (INIS-BR—928) **Reevaluation of simple radiological study importance, on the lumbar pain diagnosis investigation.** Cavalca, I.S.; Pinheiro, R.S.A.; Torres, Z.B.; Seiblitz, P.M. (Sociedade Brasileira de Radiologia, Sao Paulo). 1986. 1p. (In Portuguese). (CONF-8611223—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701468/JAW.

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From 18. meeting on radiology from Rio de Janeiro; 10. meeting on radiology residents from Rio de Janeiro; Rio de Janeiro, Brazil (19 Nov 1986).

22911 (INIS-BR—932) **Radiographics and ultrasonographic aspects of hepatical tuberculosis.** Goncalves, E.G.; Ferreira, S.M. (Sociedade Brasileira de Radiologia, Sao Paulo). 1986. 1p. (In Portuguese). (CONF-8611223—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701470/JAW.

From 18. meeting on radiology from Rio de Janeiro; 10. meeting on radiology residents from Rio de Janeiro; Rio de Janeiro, Brazil (19 Nov 1986).

22912 (INIS-mf—10846, pp 87) **Some comments on iodine-129 - brachyotherapy.** Szymczyk, W. (Instytut Onkologii, Krakow, Poland). Nov 1984. NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

22913 (INIS-mf—10846, pp 65) **Physics teaching in the postgraduate courses for roentgenologists and radiologists.** Todorov, V.S.; Popits, R.K. (Meditsinska Akademiya, Sofia, Bulgaria). Nov 1984. (In Bulgarian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

22914 (INIS-mf—10846, pp 91) **Medical cyclotron complex at the Central Research Institute of roentgenology and radiology.** Zherbin, E.; Komarov, E.; Volkov, A.; Ermakov, I.; Ilyin, L.; Sinitsin, R.; Chukovskij, O. (Tsentral'nyj Nauchno-Issledovatel'skij Rentgeno-Radiologicheskij Institute, Leningrad, USSR). Nov 1984. NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

22915 (INIS-mf—10846, pp 24) **Device for skin thickness measurements based on X-ray radiography.** Ilieva, R.; Tomov, A.; Durmishev, A. (Meditsinska Akademiya, Sofia, Bulgaria). Nov 1984. (In Bulgarian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

22916 (INIS-mf—10846, pp 29) **Mobile set for radioisotope heart examination at the patient' bed.** Kerin, T.; Ivanov, N.; Radojkov, E.; Kyurkchiev, T.; Dimitrov, I. (Vissh Voenno-Meditsinski Institute, Sofia, Bulgaria). Nov 1984. (In Bulgarian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

22917 (INIS-mf—10846, pp 47) **Computer substraction of images of thyroid tumors obtained with gamma-camera.** Mladenov, B.; Koev, A. (Meditsinska Akademiya, Sofia, Bulgaria). Nov 1984. (In Bulgarian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

22918 (INIS-mf—10846, pp 47) **Simultaneous biisotopic gamma-camera scintigraphy.** Mladenov, B.; Tsanev, Ts.; Peshev, N. (Meditsinska Akademiya, Sofia, Bulgaria). Nov 1984. (In Bulgarian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

22919 (INIS-mf—10846, pp 49) **Algorithm for noise elimination in computer tomograph image.** Naumova, R. (Meditsinska Akademiya, Sofia, Bulgaria). Nov 1984. (In Bulgarian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

22920 (INIS-mf—10846, pp 56) **Xerographic apparatus RANK XEROX 125 - substitution of the consumer paper.** Petrov, L. (Meditsinski Fakultet, Varna, Bulgaria). Nov 1984. (In Bulgarian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

22921 (INIS-mf—10846, pp 64) **Influence of the X-rays hardness on the computer tomography image.** Tabakov, S.; Dimitrov, Z. (Meditsinski Fakultet, Plovdiv, Bulgaria). Nov 1984. (In Bulgarian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

22922 (INIS-mf—10846, pp 85) **Rheoangiograph - an electroimpedance device for blood flow evaluation in limbs.** Pavlicki, G.; Palko, T. (Warsaw Univ., Poland). Nov 1984. NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

22923 (INIS-mf—10846, pp 89) **Physical background of the MR-tomography.** Ullrich, C. (Koch und Sterzel K.G., Essen, Germany, F.R.). Nov 1984. NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

22924 (INIS-mf—10846, pp 66) **Program for evaluation of cardial chamber volume in radioisotope examination with gamma camera.** Trindev, P.; Ivanov, Zh.; Shejretova, E. (Meditsinska Akademiya, Sofia, Bulgaria). Nov 1984. (In Bulgarian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

22925 (INIS-mf—10846, pp 66) **Program for quantize processing of nephrograms obtained with gamma camera.** Trindev, P.; Mushmov, D. (Meditsinska Akademiya, Sofia, Bulgaria). Nov 1984. (In Bulgarian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

22926 (INIS-mf—10846, pp 79) **Data acquisition and image processing in whole-body scintigraphy.** Markwardt, J.; Nauber, G.; Plaga, U.; Lauermann, K. (Akademie der Wissenschaften der DDR, Berlin, Germany, F.R.). Nov 1984. NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

22927 (INIS-mf—10846, pp 35) **Investigation of electron contamination of the Rocus unit photon beam.** Konstantinov, B.; Ivanova, K.; Penchev, V. (Meditsinska Akademiya, Sofia, Bulgaria). Nov 1984. (In Bulgarian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

22928 (INIS-mf—10846, pp 42) **Program for calculation of tissue inhomogenity effects in computer-assisted dose planning of isocentric gamma-therapy.** Milchev, V. (Nauchno-Izsledovatelski Onkologichen Institute, Sofia, Bulgaria). Nov 1984. (In Bulgarian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

22929 (INIS-mf—10846, pp 43) **Experimental check of the accuracy of three methods for assessment of influence of tissue heterogenities on dose distribution.** Milchev, V. (Nauchno-Izsledovatelski Onkologichen Institute, Sofia, Bulgaria). Nov 1984. (In Bulgarian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

22930 (INIS-mf—10846, pp 67) **Some relationships between Tsub(eff), absorbed dose and administered activity for thyroid carcinoma treatment with ^{131}I.** Khadzhieva, T. (Nauchno-Izsledovatelski Onkologichen Institute, Sofia, Bulgaria). Nov 1984. (In Bulgarian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

22931 (INIS-mf—10846, pp 29) **Radionuclide method for determination of the expelling function of the left heart chamber with automatic substraction of the background activity.** Kerin, T.; Dimitrov, I. (Vissh Voenno-Meditsinski Institute, Sofia, Bulgaria). Nov 1984. (In Bulgarian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

22932 (INIS-mf—11125) **Computed tomography of the temporal bone and orbit. Technique of direct multiplanar, high-resolution CT and correlative cryosectional anatomy.** Zonneveld, F.W. (Rijksuniversiteit Utrecht (Netherlands)). 20 Oct 1987. 222p. NTIS (US Sales Only), PC A10/MF A01. Order Number TI88701760/JAW.

Contains summary in Dutch, glossary of terms and subject index.

The basis for this dissertation is the combination of the best set of high-resolution CT scanning parameters, on the one hand, and the technique of scanning perpendicular to the tissue interface, or parallel to an elongated anatomical structure (direct multiplanar CT technique) on the other. Although this technique yields better visualization of a number of anatomical details, the problem remains that the radiologist is as yet unfamiliar with these alternative cross-sectional planes. For this reason, a technique for cryosectioning fresh frozen specimens was selected and improved to create cross-sectional images that can be correlated with the direct multiplanar CT scans. The selection of special scan planes, the positioning, preparation and examination of the patient, and the CT and correlative anatomy are discussed separately for the temporal bone and the orbit. A few clinical applications are discussed. In the orbit, the value of high-resolution CT is demonstrated in the establishment of the relationship between space-occupying lesions and the optic nerve, and in the management of fractures of the orbital floor. 548 refs.; 253 figs.; 24 tabs.

22933 (INIS-SU—432, pp 286-287) **Differential diagnosis of liver tumor by means of computerized tomography.** Kolesnikova, E.K.; Ostrovtsev, I.V. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

22934 (INIS-SU—432, pp 334-335) **Principles verifying large intestine neoplasm recurrences in patients who have undergone radical operations.** Petrova, I.S.; Ostapenko, T.A. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

22935 (INIS-SU—432, pp 208-209) **Potentialities of use of electrogammography and electrogammascanography in oncologic practice.** Atkochyus, V.B.; Valutskas, K.K.; Kavalyauskas, R.A.; Mamontov, V.V.; Shuminas, A.M. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

22936 (INIS-SU—432, pp 244) **On importance of general combined examination of bone system in lymphogranulomatosis of children.** Godin, V.P.; Petsko, A.R.; Polyakov, V.E.; Aplevich, N.N. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

22937 (INIS-SU—432, pp 268-269) **Radionuclide and sonographic improving diagnosis in planning of treatment of patients with malignant tumors.** Zubovskij, G.A.; Smirnov, Yu.N. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

22938 (INIS-SU—432, pp 203) **Results of chemoradiation treatment of nasopharynx cancer.** Aliev, B.M. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

22939 (INIS-SU—432, pp 213-214) **Optimization of treatment of head and neck tumors by means of individual selection of antitumoral preparation.** Bajmakanova, S.Sh.; Rakhmetova, A.U.; Adil'gereeva, R.Kh. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

22940 (INIS-SU—432, pp 218) **Combined treatment of rectum cancer using neutron sources.** Berdov, B.A.; Sidorchenkov, V.O.; Kolcherina, A.A. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

22941 (INIS-SU—432, pp 244-245) **Modern aspects of combined treatment of patients with rectum cancer.** Goldobenko, G.V.; Knysh, V.I.; Barsukov, Yu.A.; Ozhiganov, E.L.; Tkachev, S.I. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

22942 (INIS-SU—432, pp 286) **Dosimetric and radiobiological optimization of radiation component in combined and compreheusive treatment of oncologic patients.** Kozlov, A.P.; Afanas'ev, B.P.; Akimov, A.A. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

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22943 (INIS-SU—432, pp 310) **Chemotherapy in treating disseminated of larynx and laryngopharynx neoplasm.** Mardaleishvili, K.M.; Dzhordzhadze, N.A. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

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22944 (INIS-SU—432, pp 313-314) **Contact radiotherapy in complex treatment of neoplasms of oral cavity organs.** Matyakin, G.G.; Melenchuk, I.P.; Shumaeva, O.D.; Shcherbakov, S.D.; Moskovskij, V.N. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

22945 (INIS-SU—432, pp 318-319) **Electrocoagulation in combination with radiotherapy in complex treatment of esophagus cancer.** Mirson, B.M.; Kurbangel'diev, A.V.; Dzhumanazarov, A.D. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

22946 (INIS-SU—432, pp 398) **Role of regional vasculirization in forecasting efficiency of chemoradiotherapy of malignant tumours of head and neck.** Chizh, G.I.; Birina, L.M.; Il'yasov, B.B.; Gozulov, I.G. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

22947 (INIS-SU—432, pp 404-405) **Experience of application of local SHF-hyperthermia in complex treatment of rectum cancer.** Shek, B.A.; Kim, S.E.; Savochkina, T.V.; Rakhimov, T.I.; Tashbekov, T.U. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

22948 (ITEF—39(1987)) **Program control driver for a proton irradiation facility of a biomedical complex.** Verebryusov, V.S.; Komarnitskij, N.A.; Sidorov, A.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 9p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701113/JAW.

Rules for access to the ME, SYS program driver designed for controlling a proton irradiation facility at the Institute of Theoretical and Experimental Physics are described. The driver structure corresponds to the standards of real time operation system with function separation (RAFOS) for the SM-type computer. The driver is described using the "MACRO" language. 8 refs.; 1 fig.

22949 (UCRL—97818) **Clinical measurements using fiber optic sensors.** Roe, J.N. (Lawrence Livermore National Lab., CA (USA)). Sep 1987. Contract W-7405-ENG-48. 14p. (CONF-8706274—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005624/JAW.

From NATO advanced study institute; Cape Sounion Beach, Greece (20 Jun 1987).

The use of fiber optics in clinical measurements for illumination and imaging is widespread, but a moré advanced sensing concept can be realized. The attachment of species specific fiber terminations at the distal end of the fiber optic so that in-situ analysis can be made is discussed along with measurement instrumentation. These terminations are called optrodes (optical electrodes), and a group of optrodes are presently under development for the in-vivo and in-vitro identification and quantification of species of interest to the clinician. The current development includes pH, carbon dioxide, potassium, and anti-cancer drugs. 6 refs., 8 figs.

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REFER ALSO TO CITATION(S) 20787, 21142, 21143, 21144, 21145, 21182, 21197

22950 (DOE/CH/10093—6, pp 65) **Screening and characterizing oleaginous microalgal species from the Southeastern United States.** Tadros, M. (Alabama A & M Univ., Normal). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

This project will collect microalgae from various freshwater and saline habitats in the Southeastern US, isolate and define culture conditions of high lipid yielding strains of microalgae, and determine lipid yield and growth rate from selected cultures of microalgae. The work under this subcontract will emphasize collecting, isolating, and characterizing microalgae from habitats of the Southeastern US. Collections will be made from habitats that are exposed to extreme environmental conditions, such as intertidal salt marshes, temporary ponds, puddles, and marshes. Microalgae will be isolated and screened for tolerance to high temperature, high light intensity, and media requirements. Those species capable of growth in outdoor light and high temperatures will be grown in culture and qualitatively evaluated for lipid yield. Those species designated most promising will be grown under various culture conditions that generally result in lipid accumulation and will be analyzed for total lipid, protein, and dry weight.

22951 (DOE/CH/10093—6, pp 66) **Collection of high energy yielding strains of saline microalgae from the southwestern states.** Sommerfield, M. (Arizona State Univ., Tempe). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

The primary purpose of this research is to collect and select for high performance microalgal species from Southwestern locations that can serve as the raw material or biomass required to make microalgae culture technology a plausible avenue for the production of fuels. The specific objectives are to (1) collect species/strains of microalgae from a diversity of saline habitats at numerous locations in the desert Southwest; (2) isolate strains that grow well as elevated salinities and high light intensities; and (3) characterize selected strains for hydrocarbon, triglyceride, and carbohydrate accumulation. Collections were made from sites in the Southwest that would favor desired characteristics and select for strains that are either dominant at the time of collection or become dominant in enriched media at high light. Maximum yields of microalgae under enhanced conditions were determined. In addition, the lipid and carbohydrate yield was determined and the temperature and salinity ranges for optimum growth were evaluated for at least eight of the most promising species.

22952 (DOE/CH/10093—6, pp 67) **Development of an outdoor raceway system for production of oil-rich halotolerant microalgae.** Arad, S. (Ben-Gurion Univ. of the Negev, Beer-Sheva, Israel). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

The objective of this project is to develop critical aspects of the technology that will ultimately lead to commercial production of liquid fuels from microalgae. The approach involves (1) defining culture strategies for obtaining optimal biomass yields in outdoor culture for Isochrysis galbana and Nannochloropsis salina, (2) optimizing lipid yield in outdoor culture for Nannochloropsis and Chaetoceros, (3) defining the influence of biomass moisture content on the efficiency and economics of lipid extraction, and (4) developing the concept of enforced flocculation for harvesting of saline microalgae.

22953 (DOE/CH/10093—6, pp 68) **Chemical properties of microalgae with emphasis on lipids.** Tornabene, T. (Georgia Institute of Technology, Atlanta). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

The major objective of this subcontract is to provide the analytical capability required for selecting strains of microalgae with high energy contents, as well as providing insight on the mechanisms for optimizing the energy yield from algae. A specific objective will be to determine the time course between nitrogen deficiency and lipid accumulation in four strains of microalgae. Three activities were defined to accomplish the project objectives: (1) determine and quantify the chemical composition of microalgae and macroalgae submitted by other investigators working in the program, with emphasis on lipids; (2) determine the effects of culture conditions alterations or imposed stresses on the chemical composition of microalgae and (3) determine the time course relationship between nitrogen deficiency, carbohydrate accumulation, and subsequent lipid synthesis using radioisotope tracers in four strains of microalgae.

22954 (DOE/CH/10093—6, pp 69) **Effects of fluctuating environment on the selection of high yielding microalgae.** Benemann, J. (Georgia Institute of Technology, Atlanta). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

The major objectives of this project are to develop and document a system for rapid selection of high yielding microalgae that will be competitive in outdoor culture, and to initiate the development of a protocol to select from among these species those particularly suitable for use in two-stage, lipid-induction systems. Interactions were defined between levels of oxygen, pH, light, and fluctuating temperature and the dominance of high yielding strains of microalgae. From this information, ten strains of microalgae supplied by SERI were ranked for relative outdoor yield and competitiveness. In addition, lipid induction was examined as a function of nitrogen and light levels.

22955 (DOE/CH/10093—6, pp 70) **Characterization of photosynthetic efficiencies and growth of selected microalgae in dense cultures.** Redmer, R. (Martek Corp., Columbia, MD). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

The overall objective of this project is to establish the effects of environmental conditions on growth and photosynthetic efficiency in dense cultures of selected species. Research concentrated on the effects of temperature. Specific objectives are to (1) optimize and compare photosynthetic efficiency for warm-adapted and cold-adapted strains of microalgae and (2) examine the relationship between photosynthetic efficiencies determined under constant temperature conditions and those measured under fluctuating temperature regimes more representative of the outdoor culture environment. The emphasis was on an examination of relationships between temperature and photosynthetic efficiency in dense cultures. SERI supplied strains of promising microalgae, both cold- and warm-water adapted strains. Initially, growth rates were determined for each strain under optimum conditions of illumination and carbon and nutrient supply. Photosynthetic efficiency was then maximized in dense cultures. A second activity was to determine temperature factors that govern the response of algal cultures to day/night temperature regimes.

22956 (DOE/CH/10093—6, pp 71) **Collection of high energy yielding strain of saline microalgae from Southern Florida.** Ryther, J. (Harbor Branch Foundation, Inc., Fort Pierce, FL). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

The principal purposes of this research are to (1) to collect and select for high performance microalgal species from saline habitats in South Florida that can serve as the basis for making microalgae culture technology feasible for the production of fuels and (2) characterize the interaction between pH, carbon type, and carbon concentration with the potential yield of marine microalgae. Collections were made from sites in South Florida and the Florida Keys that would favor desired characteristics and select for strains that are dominant at time of collection, strains that become dominant in enriched media, or chromophytes that are isolated after exclusion of other strains.

22957 (DOE/CH/10093—6, pp 72) **Nutritional requirements for maximal growth of oil producing microalgae.** Rhyne, C. (Jackson State Univ., MS). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

The objective of this project is to define the nutritional requirements for primary oil producing microalgae that lead to optimal growth, including optimal amounts of nitrogen and phosphorus, and optimal quantities of secondary nutrients e.g., vitamins and trace elements. The primary nutritional requirements of the species were established. Experiments were run to determine the optimal (a) nitrogen source: nitrate, ammonia, urea; (b) concentration for nitrogen and phosphorus (and silica for diatoms); and (c) possible synergism between nitrogen and phosphorus. The second nutritional requirements of the species will also be established. Experiments shall be run that (a) define the necessity for vitamins (+ or -); (b) define the necessity for, and optimal concentration of, key trace elements such as iron; and (c) establish interactions between trace element requirements and pH.

22958 (DOE/CH/10093—6, pp 73) **Production of liquid fuels and chemicals by microalgae.** Weissman, J. (Microbial Products, Inc., Vacaville, CA). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

The overall objective of this research activity is to determine the feasibility of using a simple, open-pond system to produce high yields of lipid-producing microalgae at low cost for potential energy applications. The research will determine suitable species, yields, and operating parameters. A number of microalgae species will be inoculated into the ponds to determine which species offer potential for high lipid yield. Additional data analyses will be performed on the physical, chemical, and biological responses of the algal species to system operational parameters. Research will also analyze the production of protein, lipids, and carbohydrates by various species. Laboratory-scale support studies will be conducted as necessary, and production system performance sensitivities will be analyzed for the final evaluation. A previous contract with EnBio resulted in the design, site preparation, and partial construction of an experimental algae culture facility. Under this original subcontract, two 200-m^2 outdoor ponds and one 100-m^2 outdoor pond were constructed and made operational. Studies have shown that the microalgae Ankistrodesmus and Scenedesmus will establish productive monocultures in outdoor culture. Yields of 20 g/m^2-day at 25% lipid have been achieved. A continuous culture strategy has proven more productive than a batch culture strategy. Using media

recycle and reduced mixing speeds, costs of production have been significantly reduced.

22959 (DOE/CH/10093—6, pp 74) **Collection and selection of high energy thermophilic strains of microalgae.** Cooksey, K.E. (Montana State Univ., Bozeman). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

The main objective is to collect and select strains of microalgae that will perform well in outdoor culture and yield high-energy fuel products. Specific objectives are to (1) collect and isolate strains from saline thermal waters and soils in Wyoming and Montana, (2) determine the effects of nitrogen vs. sulfur limitation on lipid accumulation of select strains of microalgae, and (3) evaluate the use of flow cytometry to select for high lipid yielding strains of microalgae. Microalgae were collected that grow in saline waters and soil. Organisms were isolated from enriched cultures. Cultures of selected strains were grown in both balanced and unbalanced media (sulfur, nitrogen limitation). Lipids were extracted from cells and measured. Also, a flow cytometer was used to determine if microalgal cells could be sorted according to lipid content and remain viable.

22960 (DOE/CH/10093—6, pp 77) **Algal genetics.** Neushul, M. (Neushul Mariculture, Inc., Goleta, CA). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

Developmental and physiological features of selected macro- and microalgae were identified that might be amenable to genetic manipulation. A review of the current status of micro- and macroalgal genetic technology was done to identify possible genetic vectors and techniques for the genetic manipulation of algae. The heritability of morphological, physiological, and biochemical traits in selected micro- and macroalgae was studied, and new techniques to study algal genetics were explored. In addition, efforts to use mutagens to produce, isolate, and identify mutants were continued. This project emphasizes measurements of floating drift algae and studies of microalgae. Morphological and cytological features will be evaluated from photographs and photomicrographs. Breeding trials and characterization studies will be carried out to distinguish genetic and environmental components that determine several morphological, physiological, and biochemical traits and processes. In addition to hybridization, which has already been accomplished with some gametophytic strains, the contractor will evaluate ultraviolet and chemical mutagenesis.

22961 (DOE/CH/10093—6, pp 79) **Ultrastructure evaluation of lipid-producing microalgae.** Solomon, J. (Oak Ridge National Lab., TN). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

The major objective of this project is to develop a detailed understanding of the use of flow cytometry as a tool to increase lipid production of microalgae cells. This project is addressing four major areas: (1) standardizing techniques with other program researchers, (2) determining the quantitative variation in lipid content in an algal population, (3) studying the chlorophyll:lipid shift seen in lipid-accumulating cells, and (4) sorting high and low lipid populations for other program researchers as needed. No results are available as yet.

22962 (DOE/CH/10093—6, pp 80-81) **Genetic variation of high energy yielding strains of microalgae.** Gallagher, J.A. (City Univ. of New York, NY). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

The overall objective of this subcontract is to further establish and apply the technique of gel electrophoresis to characterize genetic variation between strains of microalgal species and to identify species most suitable for improvement through genetic manipulation. Specific objectives are (1) to continue the examination of genetic variability within Amphora and Nannochloropsis and to correlate this genetic variability with differences in photosynthetic performance and (2) to begin similar examinations of additional species which have proven to be of interest for program applications. There are three approaches taken to achieve the objectives. (1) At least 100 strains from each group will be surveyed for differences in electrophoretic banding patterns. Each strain will be grown under both nutrient-sufficient and nutrient-deficient conditions, and banding patterns will be determined for both conditions. (2) The relationship between photosynthetic rate and incident irradiance will be determined for at least 20 strains of each of the two groups. (3) At least two additional species will be selected by SERI and photosynthesis-irradiance relationships will be determined for a total number of not less than 20 strains selected from these species.

22963 (DOE/CH/10093—6, pp 83-84) **Optimization of lipid induction in microalgae.** Chelf, P.; Nagle, N.; Barclay, B. (Solar Energy Research Institute, Golden, CO). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

There are three objectives to this research: (1) to quantify the effects of environmental parameters on lipid production by nutrient limited microalgae; (2) to utilize this information to manipulate and optimize the lipid induction process; (3) to develop new, simple techniques for the rapid quantification of lipids in microalgae. Nile red, a fluorescent dye, has been adapted with success to semi-quantitatively measure neutral lipids in microalgae. Correlation between gravimetric lipid measurements and nile red fluorescence was determined to be high. Increasing light intensity up to 1000 uE m^2/s was shown to increase lipid yield in both Chaetoceros sp. and Navicula sp. Lipid contents of 50% to 60% ash-free dry weight can now be routinely induced in both a strain of Navicula and in a strain of Monoraphidium. Increasing bicarbonate concentration appears to enhance lipid production in silica limited diatoms, while decreasing lipid production in nitrogen limited diatoms and green algae. However, it has been very difficult to separate the effects of inorganic carbon supply and pH. Nitrogen limited Navicula bubbled with CO_2 and silica limited cells bubbled with air produce comparable lipid yields in 48 h. Neutral lipids comprise 85% to 93% of the total lipids in nutrient-stressed microalgae.

22964 (DOE/CH/10093—6, pp 85-86) **Microalgae species collection and screening.** Barclay, B.; Johansen, J. (Solar Energy Research Institute, Golden, CO). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

The objective of this project is to isolate microalgal strains which (1) produce high amounts of cellular lipids and (2) grow rapidly in warm saline waters of chemical composition similar to saline ground waters in the southwestern US. This objective entails isolating many algal strains and then screening them for the desired characteristics so that a small bank of highly promising candidate species is obtained. Water samples are collected in the field, returned to the laboratory, enriched, and placed on a lighted rotary screening wheel maintained at 30°C. Rapidly growing algae are then isolated from the enrichment cultures. These strains are subsequently grown on a temperature gradient table at six different temperatures, five different conductivities, and in three different water types to determine optimal growth conditions. Lastly, the species are grown at optimal growth conditions, and percentage lipid ash-free dry weights are determined for exponential and nutrient-stressed cultures. Species that grow at greater than one doubling per day and produce more than 40% AFDW lipid are retained. At present, the SERI Culture Collection contains more than 150 isolates. Of these, 27 have been completely screened. Of these 27, the following are particularly promising: Amphora coffeifomis, Chaetoceros muelleri, Cyclotella cryptica, Monoraphidium species, and Navicula saprophila.

22965 (DOE/CH/10093—6, pp 90) **Characterization of hydrocarbon-producing strains of microalgae.** Lewin, R. (Univ. of California at San Diego, La Jolla). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

The overall objective is to collect, characterize, and improve hydrocarbon-rich microalgae strains, especially Nanno-Q. Growth rates for Nanno-Q were compared at a range of temperature, salinity, nutrients (nitrate, ammonia, urea), light intensity, pH (carbon utilization), and aeration conditions. Growth was also compared in natural sea water, artificial sea water, and artificial saline desert water. Cells of Nanno-Q were subjected to U.V. irradiation. Procedures were used to select for cells yielding higher lipid content and a greater resistance to an algacide.

22966 (DOE/CH/10093—6, pp 94-95) **Transformation and somatic cell genetics for improvement of energy production in microalgae.** Meints, R.A. (Univ. of Nebraska, Lincoln). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

Viruses are known to successfully invade exsymbiont Chlorella. If a natural host could be found, other than exsymbiont Chlorella, it would allow development of a transformation system to genetically engineer microalgae using viruses as vectors. The successful search for viruses that infect microalgae will be an important first step in developing understanding of the general biology of this system and will provide the resources for a direct protoplast and transformation system in these organisms. The main objective is to develop a viral-based system for improvement of genetic strains of algae that have capability as primary producers of complex carbohydrates and lipids. Specific objectives are to (1) screen natural habitats for the free-living Chlorella, which act as hosts for this group of viruses; (2) screen for viruses that could act as vectors or produce protoplasts from microalgae; and (3) develop methodology for the production of protoplasts and subsequent somatic hybridization of these protoplasts. If a natural host is located during the screening phase, the host virus interactions will be characterized. A brief characterization of the natural free-living host, parallel to those already completed for exsymbiont algae, will be undertaken. Promising microalgae strains provided by SERI were screened with more than 75 different viruses to see if they can be infected. Also, hundreds of water samples were screened for infective viruses. Microalgal strains will be protoplasted either using a lysin prepared from their own viral lysate or by commercially available cellulases and pectinases, alone or in combination with their lysin.

22967 (DOE/CH/10093—6, pp 125-126) **Production of cellulase on mixtures of xylose and cellulose.** Grohmann, K. (Solar Energy Research Institute, Golden, CO). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

The objective of this project is to enhance the production rates of cellulases by growing a mutant of T. reesei (Rut C-30) on a mixture of xylose and cellulose. The initial phase of the project will concentrate on the evaluation of enzyme production by the Rut C-30 mutant of the fungus T. reesei in batch and fed batch modes of operation. The induction of the cellulase enzyme complex will be measured in batch cultures containing different initial concentrations of pure xylose and pure cellulose. Optimal concentrations and ratios of these substrates will thus be determined for comparison. The induction of the cellulase enzyme complex for fed batch cultures of T. reesei Rut C-30 containing different levels of pure xylose and pure cellulose will be studied in the next phase of the project. Individual substrates will be used again in control experiments. The fed batch mode of operation should improve the enzyme productivity since the relatively long time required for growth of fungal mycelia in batch cultures is decreased significantly in fed batch cultures. During the first phase of the project, the correlation between dry weight, protein content, and enzyme production for Rut C-30 has been completed. The result can be applied in growing Rut C-30 on cellulose to estimate the growth by measuring protein content. Several batch runs with different ratios of xylose to cellulose were also performed. The results of these initial experiments have confirmed the possibility of obtaining higher enzyme productivity by using mixtures of xylose and cellulose.

22968 (DOE/CH/10093—6, pp 127) **Improvements in the enzymatic hydrolysis of cellulose: strain development of Trichoderma reesei.** Montenecourt, B. (Lehigh Univ., Bethlehem, PA). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

The objectives of the project are to develop mutant strains of Trichoderma, which produce cellulase enzyme while growing on a soluble carbon source such as xylose, and to produce an enzyme complex that is less inhibited by the build up of glucose. The mutant MCG-80 created at the Army Natick Laboratories was selected from a number of potential fungal mutants, and the mutation conditions optimized. Screening techniques were developed that allow rapid selection for the desired traits: ability to grow and produce cellulase while using a soluble carbon source, decreased end-product inhibition, and increased specific activity. Several promising mutants have been selected and are being evaluated.

22969 (DOE/CH/10093—6, pp 134-135) **Enzyme recycle.** Himmel, M.E. (Solar Energy Research Institute, Golden, CO). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

The β-glucosidase component of the cellulase enzyme complex has a relatively short lifetime in solution and cannot be recycled by adsorption on cellulose. Improvements in enzyme lifetime and definition of a recycle approach will result in sharply reducing the cost of enzyme utilization for biomass-to-ethanol conversion schemes. The objective of this project is to evaluate the potential of a chemical crosslinking methodology to enhance the enzyme-stability of fungal β-glucosidases and modify the structure for improved recovery. Three phases have been identified to accomplish the project objective. First, the baseline characterization describing the denaturation process of several important β-glucosidases will be determined by the combination of classical activity-temperature assay, differential scanning microcalorimetry, and tryptophan fluorescence measurements. Then, a series of bifunctional crosslinking reagents will be applied to these β-glucosidases with concomitant analysis of the effectiveness (e.g., increased stability) of the reagent using the methods described above. Finally, selected chemical crosslinking reagents will be used to link the β-glucosidase enzyme to the endoglucanase or cellobiohydrolase in the presence of active-site protection agents. A thermal-stable β-glucosidase has been isolated from the new thermophilic, cellulolytic bacteria Acidothermus cellulolyticus by SERI researchers. This enzyme will be used as a research standard for the interpretation of differential thermal scanning and fluorescence data for the case of an authentic thermotolerant β-glucosidase.

22970 (DOE/CH/10093—6, pp 136-137) **Evaluation of thermal stable cellulase from Acidothermus cellulolyticus.** Himmel, M.E. (Solar Energy Research Institute, Golden, CO). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

The objective of this project is to evaluate the highly thermal-stable cellulase complex produced by the thermophilic bacteria Acidothermus cellulolyticus as a substitute for the less stable fungal cellulase enzymes currently under consideration. Four tasks have been defined to accomplish the project objective. First, the cellulase complex from Acidothermus will be analyzed in an unpurified state for temperature optima, temperature resistance, and sensitivity to potential interfering agents. Then, the individual active components from this cellulase system will be isolated and purified, and the overall features of these enzymes will be compared to those of fungal cellulases. In the third step, SERI researchers will perform structural and kinetic characterization of the key Acidothermus cellulase enzymes with the goal of understanding the unique thermophily of these novel enzymes. Finally, cellulase component synergism studies will be performed in which purified Acidothermus cellulase enzymes are used to augment fungal cellulase systems under conditions of thermal stress. As a result of the first two tasks, the cellulase complex as secreted from Acidothermus was found to

display filter paper and carboxymethylcellulose degrading optima of 75° and 82°C, which renders this cellulase complex the most thermally stable of all bacteria or fungi reported to date. Thus, the hydrolysis reaction could be performed at higher temperatures than possible previously, possibly with enhanced rates. The cellulase enzyme complex produced by Acidothermus also appears to consist of two active components, one approximately 185,000 mol. weight and the other much smaller (25,000 mol. weight). These relatively low molecular weights could be a significant asset in improving substrate susceptibility and hydrolysis rates.

22971 (DOE/CH/10093—6, pp 152-153) **Enzymatic and initial genetic studies on methanobacteria.** Ho, N.W.Y. (Purdue Research Foundation, West Lafayette, IN). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

The objective of this work is to take advantage of the newly developed genetic technology to elucidate enzymatic mechanisms in methanogenesis and improve bacteria for higher methane production. Work on this project if focusing on the development of a transformation system for Methanobacterium thermoautotrophicum (M.Th.) (and further, for other methanogens) to study the biochemical pathways and reactions of methanogenesis, by first developing shuttle plasmids and transferring genes between bacteria, and characterizing the methylreductase enzyme system. Results of this research have established a selection method via antibiotic G418 sensitivity for development of a transformation system for M.th.; constructed potential cloning vectors (plasmids pLM1 and pLM3) for the transformation; and determined optimum conditions for the isolation, purification, and fragmentation of the methylreductase subunits from M.th.

22972 (DOE/CH/10093—6, pp 155-156) **Effects of molecular hydrogen on acetate degradation by methanogens.** Boone, D.R.; Mah, R.A. (Univ. of California, Los Angeles). Jul 1987. NTIS, PC A16/MF A01. Order Number DE87001140/JAW.

In Biofuels and municipal waste technology research program summary: FY 1986.

Work has centered on acetate-degrading Methanosarcina strains under various concentrations of hydrogen and co-cultures with other synergistic anaerobic bacteria. Efforts are focusing on the determination of the optimum levels of the concentrations, nutrient requirements, and synergism between bacteria to enhance methane production. It was found that low (ca. 0.2 μM of H_2) concentrations had no discernible effect on the degradation of acetate by M. barkeri, but the cultures were unable to utilize hydrogen as a catabolic substrate at such low concentrations. Higher levels (ca. 50 μM) of hydrogen usually did not significantly affect acetate degradation, and at these levels M. barkeri was able to convert the hydrogen to methane. Higher levels of hydrogen, added directly to the cultures by bubbling gas, did inhibit aceticlastic methanogenesis. Furthermore, it was found that hydrogen-grown cultures of M. barkeri are unable to utilize acetate except after a prolonged lag-phase. It was also noted that if acetate is present when hydrogen is exhausted, no inhibition results. That is, inhibition occurs only when stationary-phase cultures are used for inoculum.

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REFER ALSO TO CITATION(S) 20989, 23002, 23209

22973 **(AD-A—186805/8/XAB) Review of the scientific literature and preparation of an annotated bibliography on effects of cigarette smoking and nicotine on human performance. Volume 1. Final report.** Millis, R.M. (Associate Consultants, Inc., Washington, DC (USA)). 1986. 187p. NTIS, PC A09/MF A01.

See also Volume 2, AD-A186 806.

22974 **(AD-A—186806/6/XAB) Review of the scientific literature and preparation of an annotated bibliography on effects of cigarette smoking and nicotine on human performance. Volume 2. Final report.** Millis, R.M. (Associate Consultants, Inc., Washington, DC (USA)). 1985. 156p. NTIS, PC A08/MF A01.

See also Volume 1, AD-A186 805.

22975 **(AD-A—187238/1/XAB) Revised health risk assessment for the use of hexachloroethane smoke on an Army training area. Final report.** Novak, E.W.; Lave, L.B.; Stukel, J.J.; Schaeffer, D.J. (Army Construction Engineering Research Lab., Champaign, IL (USA)). Sep 1987. 59p. (CERL-TR-N—87/26). NTIS, PC A04/MF A01.

Hexachloroethane (HC) smoke in pots, grenades, and artillery rounds has been used in military training exercises since the Second World War. Chamber tests generating HC smoke with scaled-down smoke pots consistently show the presence of perchloroethylene, carbon tetrachloride, hexachloroethane, hexachlorobenzene, cadmium, and arsenic, all of which have been determined to be carcinogenic in laboratory animals or in humans. The objective of this study was to develop a worst-practicable-case scenario of Army troop exposure in training and then to calculate to total absorbed dosage and attendant cancer risk from a feasible number of repetitive exposures at the site. Risk estimates were also made for civilian populations surrounding the installation. This study recommends (1) the Army enforce its directive to mask in the presence of HC smoke, (2) the Army closely regulate the deployment of HC and other smokes on all of its installations, (3) studies should be conducted on Army installations to determine the risk from HC smokes to which the soldier and local populace are exposed, (4) an annual HC smoke risk of cancer to soldiers of greater than 1 in 10,000 should be reduced where perceived, and (5) the Army should adopt a safety principle- as low as reasonably achievable - for both troop and civilian exposure to HC-smokes.

22976 **(BNL—40436) A critical analysis of relation of hemopoiesis to bone marrow stroma.** Cronkite, E.P. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 25p. (CONF-8708206—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003500/JAW.

From Annual meeting of the Japanese Pathology Society; Tokyo, Japan (28 Aug 1987).

This essay describes a personal interpretation of how blood cell production is regulated. Hemopoiesis in man and animals other than the rodent normally takes place in the bone marrow. The bone marrow consists of the extracellular biochemical constituents, the circulation of blood, and the cellular constituents that support hemopoiesis and the constituents that produce the blood cells for distribution into the blood and throughout the body. The extracellular microenvironment is intimately connected to certain cells that produce these molecules. Proteoglycans, chondroitin sulfate, glycosoaminoglycans also certainly play an important role in hemopoiesis but will not be considered in this dissertation. 38 refs., 5 figs.

22977 **(PB—88-131529/XAB) Health and Environmental Effects Profile for Brominated Diphenyl Ethers.** (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). Jan 1984. 41p. (EPA—600/X-84/133). NTIS, PC A03/MF A01.

The Health and Environmental Effects Profile for Brominated diphenyl ethers was prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH for the Office of Solid Waste to support listings of hazardous constituents of a wide range of waste streams under Section 3001 of the Resource Conservation and Recovery Act (RCRA). Both published literature and information obtained from Agency program office files were evaluated as they pertained to potential human health, aquatic life and environmental effects of hazardous waste constituents. Quantitative estimates are presented provided sufficient data are available. Pentabromodiphenyl ether, Octabromodiphenyl ether and Decabromodiphenyl ether are determined to be systemic toxicants. An Acceptable Daily Intake (ADI), defined as the amount of a chemical to which humans can be ex-

posed on a daily basis over an extended period of time (usually a lifetime) without suffering a deleterious effect, for Pentabromodiphenyl ether is .00044 (mg/kg bw/day), for Octabromodiphenyl ether is .00062 (mg/kg bw/day) and for Decabromodiphenyl ether is .01 (mg/kg bw/day) for oral exposure.

22978 **(PB—88-131743/XAB) National Toxicology Program annual plan for fiscal year 1987.** (National Toxicology Program, Research Triangle Park, NC (USA)). May 1987. 190p. (NTP—87-001). NTIS, PC A09/MF A01.

See also PB—88-131750 and report for FY 1986, PB—87-164729.

The Secretary of Health and Human Services established the National Toxicology Program to coordinate and strengthen the Department's activities in characterizing the toxicity of chemicals. The Program is mandated by the Secretary with: (1) broadening the spectrum of toxicologic information obtained on selected chemicals; (2) increasing the numbers of chemicals studied, within funding limits; (3) developing and validating tests and protocols responsive to regulatory needs; and (4) communicating Program plans and results to government agencies, the medical and scientific communities, and the public.

22979 **(PB—88-136999/XAB) Identifying and regulating carcinogens. Background paper.** (Office of Technology Assessment (U.S. Congress), Washington, DC). Nov 1987. 254p. (OTA-BP-H—42). NTIS, PC A12/MF A01.

Also available from Supt. of Docs.; Library of Congress catalog card No. 87-619859.

Contents include: Introduction and summary; policies for testing, assessing, and regulating carcinogens; federal agency assessment and regulation of carcinogens; the national toxicology program; agency responses to the annual report on carcinogens and NCI/NTP test results; statutory authority for regulating carcinogens; chemicals listed in annual report on carcinogens and NCI/NTP test results.

22980 **(PB—88-137757/XAB) Health and environmental effects profile for bromobenzenes.** (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). Jan 1984. 62p. (EPA—600/X-84/128). NTIS, PC A04/MF A01.

The Health and Environmental Effects Profile for Bromobenzenes was prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH for the Office of Solid Waste to support listings of hazardous constituents of a wide range of waste streams under Section 3001 of the Resource Conservation and Recovery Act (RCRA). Both published literature and information obtained from Agency program office files were evaluated as they pertained to potential human health, aquatic life and environmental effects of hazardous-waste constituents. Quantitative estimates have been presented provided sufficient data are available. Existing data are insufficient to determine an Acceptable Daily Intake (ADI) or a carcinogenic potency factor for Bromobenzenes as a class. 1,4-Dibromobenzene, 1,2,4-Tribromobenzene and Hexabromobenzene have been determined to be systemic toxicants. An Acceptable Daily Intake (ADI), defined as the amount of a chemical to which humans can be exposed on a daily basis over an extended period of time (usually a lifetime) without suffering a deleterious effect, for 1,4-Dibromobenzene is .01 (mg/kg bw/day), for 1,2,4-Tribromobezene is .005 (mg/kg bw/day) and for Hexabromobenzene is .002 (mg/kg bw/day) for oral exposure.

22981 **(PB—88-137773/XAB) Health and environmental effects profile for 1,2-dimethylhydrazine.** (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). Jan 1984. 53p. (EPA—600/X-84/135). NTIS, PC A04/MF A01.

The Health and Environmental Effects Profile for 1,2-dimethylhydrazine was prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH for the Office of Solid Waste to support listings of hazardous constituents of a wide range of waste streams under Section 3001 of the Resource Conservation and Recovery Act (RCRA). Both published literature and information obtained from Agency program office files were evaluated as they pertained to potential human health, aquatic life, and environmental effects of hazardous-waste constituents. Quantitative estimates have been presented provided sufficient data are available. 1,2-Dimethylhydrazine has been evaluated as a carcinogen. The human carcinogen potency factor (q1*) for 1,2-dimethylhydrazine is 1400 per (mg/kg bw/day) for oral exposure.

22982 **(PB—88-137831/XAB) Health and environmental effects profile for 1,1′-biphenyl.** (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). Jan 1984. 34p. (EPA—600/X-84/147). NTIS, PC A03/MF A01.

The Health and Environmental Effects Profile for 1,1′-biphenyl was prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH for the Office of Solid Waste to support listings of hazardous constituents of a wide range of waste streams under Section 3001 of the Resource Conservation and Recovery Act (RCRA). Both published literature and information obtained from Agency program office files were evaluated as they pertained to potential human health, aquatic life and environmental effects of hazardous waste constituents. Quantitative estimates have been presented provided sufficient data are available. 1,1′-Biphenyl has been determined to be a systemic toxicant. An Acceptable Daily Intake (ADI), defined as the amount of a chemical to which humans can be exposed on a daily basis over an extended period of time (usually a lifetime) without suffering a deleterious effect, for 1,1′-biphenyl is .05 (mg/kg bw/day) for oral exposure.

22983 **(PB—88-139597/XAB) Health aspects of toluene and xylene exposures associated with motor gasoline.** Eyres, A.R. (Concawe, The Hague (Netherlands)). 1987. 19p. (CONCAWE—7/87). NTIS, PC E03/MF E01.

In response to concerns that exposures to toluene and xylenes during the manufacture, distribution, and use of motor gasolines may present similar risks to the potential blood and bone marrow abnormalities from over-exposure to benzene, the report reviews current scientific knowledge on human and animal health effects. Data are also presented on the ranges of concentrations of toluene and xylenes in European gasolines and on exposures to their vapors during the manufacture and distribution of motor gasolines.

22984 **(PB—88-144324/XAB) Functional consequences of prenatal methylmercury exposure: effects on renal and hepatic responses to trophic stimuli and on renal excretory mechanisms.** Slotkin, T.A.; Kavlock, R.J.; Cowdery, T.; Orband, L.; Bartolome, M. (Duke Univ., Durham, NC (USA). Dept. of Pharmacology). 1986. 17p. NTIS, PC A03/MF A01.

Pub. in Toxicology Letters, Vol. 34, 231-245(1986).

The effects of prenatal exposure to methylmercury on the functional development of renal and hepatic response systems was examined in the developing rat. Methylmercury produced an elevation of basal activity of renal ornithine decarboxylase (ODC, an enzyme involved in regulation of cellular maturation) and an eventual relative hypertrophy; liver ODC was reduced and hypertrophy was not evident. In contrast, the reactivity of liver ODC to trophic stimulants (vasopressin, isoproterenol) was markedly enhanced by prenatal methylmercury exposure, whereas renal ODC responses were much less affected (vasopressin) or actually reduced (isoproterenol). Targeted actions of methylmercury on renal excretory function were also prominent, with increased fractional excretions urea and electrolytes and an eventual reduction in glomerular filtration as assessed by creatinine clearance. These studies show that doses of methylmercury ordinarily associated with selective actions on development of neurobehavioral patterns also influence the functional ontogeny of other organ systems; furthermore, the fact that the target tissues are different for prenatal vs postnatal methylmercury exposure, indicates that the functional teratology of methylmercury exhibits critical periods of sensitivity.

22985 **(PB—88-144407/XAB) Effects of neonatal methylmercury exposure on adrenergic-receptor binding sites in peripheral tissues of the developing rat.** Slotkin, T.A.; Kavlock, R.J.; Cowdery, T.; Orband, L.; Bartolome, M. (Duke Univ., Durham, NC (USA). Dept. of Pharmacology). 1986. 14p. NTIS, PC A03/MF A01.

Pub. in Toxicology, Vol. 41, 95-106(1986). See also report dated 1985, PB—86-120334.

Neonatal exposure to methylmercury produces changes in patterns of tissue growth and function, in part, due to alterations in adrenergic neuronal input. To explore the mechanisms by which these changes come about, newborn rats were exposed to methylmercury (1 or 2.5 mg/kg/day) throughout the preweaning stage and the ontogeny of adrenergic receptor binding sites evaluated in liver, kidney, heart and lung, using (^{3}H)prazosin (alpha 1-receptors), (^{3}H)rauwolscine (alpha 2-receptors) and (^{125}I)pindolol (beta-receptors). In the kidney, methylmercury caused decreases in beta- and alpha 1-receptor binding and increases in alpha 2-binding, and the alterations persisted into adulthood; previous work has shown that beta-receptor-mediated responses are generally enhanced in methylmercury-exposed pups, and the down-regulation of beta-receptor binding thus probably represents a compensatory action secondary to alterations in post-receptor coupling mechanisms. The effects of methylmercury on hepatic adrenergic receptors were different from those seen in the kidney, with substantial elevations in beta- and alpha-receptor binding apparent in the preweaning stage; this agrees also with the differences in effects of the mercurial on trophic reactivity and growth in the two tissues.

22986 **(PB—88-856273/XAB) Chromium toxicity. January 1978-December 1986 (citations from the Life Sciences Collection data base). Report for January 1978-December 1986.** (National Technical Information Service, Springfield, VA (USA)). Jan 1988. 150p. NTIS PC N01/MF N01.

This bibliography contains citations concerning the biological effects of chromium exposure. The effects on protein metabolism and kidney and liver functions are discussed, and the role of chromium as a carcinogenic agent and its antigenicity are also considered. Sources of chromium contamination including occupational exposure and pollution are discussed, and methods of analysis are described. (This updated bibliography contains 375 citations, none of which are new entries to the previous edition.)

22987 **(PB—88-856281/XAB) Chromium toxicity. January 1987-December 1987 (citations from the Life Sciences Collection data base). Report for January 1987-December 1987.** (National Technical Information Service, Springfield, VA (USA)). Jan 1988. 33p. NTIS PC N01/MF N01.

Supersedes PB—87-852398.

This bibliography contains citations concerning the biological effects of chromium exposure. The effects on protein metabolism and kidney and liver functions are discussed, and the role of chromium as a carcinogenic agent and its antigenicity are also considered. Sources of chromium contamination including occupational exposure and pollution are discussed, and methods of analysis are described. (This updated bibliography contains 56 citations, all of which are new entries to the previous edition.)

22988 **(PB—88-857057/XAB) Vinyl chloride and polyvinyl chloride: toxicology. January 1978-January 1988 (citations from the Life Sciences Collection data base). Report for January 1978-January 1988.** (National Technical Information Service, Springfield, VA (USA)). Jan 1988. 154p. NTIS PC N01/MF N01.

Supersedes PB—87-854428.

This bibliography contains citations concerning the toxicity of vinyl chloride and polyvinyl chloride following short and long-term exposures. Metabolism, carcinogenicity, and teratogenic potential of these substances are considered. Methodology to quantitate their presence in atmospheric dust and body tissues are discussed. Occupational hazards are also noted. (This updated bibliography contains 327 citations, 87 of which are new entries to the previous edition.)

22989 **(PB—88-857065/XAB) Polychlorinated biphenyls in foods. August 1984-January 1988 (citations from the Food Science and Technology Abstracts data base). Report for August 1984-January 1988.** (National Technical Information Service, Springfield, VA (USA)). Jan 1988. 88p. NTIS PC N01/MF N01.

Supersedes PB—87-855060.

This bibliography contains citations concerning the presence of polychlorinated biphenyls (PCB) in food products. The toxicology of PCB's, analytical methods to detect and quantitate their presence, and legislation are discussed. Food products considered include meat, fish, fruit, dairy, vegetable oils, and packaging materials. (This updated bibliography contains 187 citations, 110 of which are new entries to the previous edition.)

22990 **(PB—88-857610/XAB) Toxicity of phthalates. January 1978-January 1988 (citations from the Life Sciences Collection data base). Report for January 1978-January 1988.** (National Technical Information Service, Springfield, VA (USA)). Feb 1988. 143p. NTIS PC N01/MF N01.

This bibliography contains citations concerning the biological effects of phthalate exposure. Measurement of phthalate levels in fish, pork, and hens is discussed. The effects of phthalates on reproductive organs, skin, lungs, liver, and blood is examined. Toxicity, carcinogenesis, and mutagenicity caused by phthalates are described. The effect of phthalates on earthworms, coral, lichen, bacteria, and mussels is briefly discussed. (Contains 287 citations fully indexed and including a title list.)

22991 **(PB—88-912900/XAB) Toxic Substances Control Act (TSCA) Test Submissions data base (TSCATS) - comprehensive update tape. Data file.** Merrick, E. (Environmental Protection Agency, Washington, DC (USA). Office of Toxic Substances). Sep 1987. mag tap. (EPA—560/7-88/012). NTIS Subscription.

See also PB—86-220860, PB—86-220795, PB—86-220878, and PB—86-220803; Source tape is in the ASCII character set. This restricts preparation to 9 track, one-half inch tape only. Identify recording mode by specifying density only. Call NTIS Computer Products if you have questions. Available on subscription, North American Continent price $1200.00/year, individual issue $300.00; all others write for quote. Issued quarterly.

The Toxic Substances Control Act Test Submissions Data base (TSCATS) was developed to make unpublished test data available to the public. The test data are submitted to the US Environmental Protection Agency by industry under the Toxic Substances Control Act. Test is broadly defined to include case reports, episodic incidents, such as spills, and formal test study presentations. The data base allows searching of test submissions according to specific chemical identity or type of study when used with an appropriate search retrieval software program. Studies are indexed under three broad subject areas: health effects, environmental effects, and environmental fate. Additional controlled vocabulary terms are assigned which describe the experimental protocol and test observations. Records identify reference information needed to locate the source document, as well as the submitting organization and reason for submission of the test data. TSCATS on magnetic is updated quarterly in March, June, September and December each year. Each update is a complete restatement of the entire data base.

5510 Physiological Systems

REFER ALSO TO CITATION(S) 22976

22992 (GSF—10/87, pp 95-99) **Gas exchange measurements to verify the part played by water stress in forest disease.** Koch, W. (Muenchen Univ., Germany, F.R. Lehrstuhl fuer Forstbotanik). Mar 1987. (In German). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88752006/JAW. (CONF-8610391—).

From Symposium on climate and weather as related to the novel forest disease; Neuherberg, F.R. Germany (13 Oct 1986).

A comparison of the gas exchange of spruce in clean air and site air is conducted in the form of a large-scale experiment in the forestry office of Thiergarten near Donaustauf, aiming especially to

continuously measure the gas exchange (net photo synthesis, transpiration, respiration) of two morphologically very similar, comparable twigs of identical age from the part of the crown receiving direct solar irradiation of a 60-year-old spruce. Nothing so far in these gas exchange measurements provides the slightest clue to the assumption that the needles of spruce exposed to gaseous air pollutants sustain additional water stress.

5520 Public Health

REFER ALSO TO CITATION(S) 20898, 21704, 21839, 21870, 21872, 21874, 21875, 21877, 21878, 21879, 21880, 22264, 22629, 22631, 22666, 22754, 22755, 22800, 22979, 22986, 22987, 23217

22993 (DOE/ER/60493—1-Vol.2, pp 449-453) **Vibration as a cause of tight-building syndrome symptoms.** Hodgson, M.J.; Permar, E.; Squire, G.; Cagney, W.; Allen, A.; Parkinson, D.K. (Univ. of Pittsburgh, PA). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The authors investigated a small outbreak of the sick-building syndrome. Symptoms on a linear analog scale as dependent and industrial hygiene measures as independent variables were analyzed with multiple regression techniques. Vibration measures showed significant zero-order correlations with complaints. Only temperature and acceleration entered more complex models. This investigative method may allow better definition of the tight-building syndrome.

22994 (DOE/ER/60493—1-Vol.2, pp 625-629) **Relative humidity of the air and ocular discomfort in a group of susceptible office workers.** Breunis, K.; de Grott, J.P. (Netherlands Postal and Telecommunications Services, Groningen). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

In a group of 60 office workers who were selected for experiencing frequent ocular discomfort (there were 15 contact lens wearers among them), the association between the relative humidity (RH) of the air and ocular discomfort was investigated. On 22 days over a one-year period questionnaires were completed by the experimental subjects at 11:00 am while at the same day RH and temperature were recorded. The analysis of 927 records showed a significant association of RH and ocular discomfort for the group of lens wearers, but not for non-lens wearers. In both groups ocular discomfort was strongly associated with perceived humidity of the air. Lens wearers tend to predict the actual value of the RH slightly better than non-lens wearers. It is concluded that ocular discomfort of lens wearers can be minimized if the RH of indoor air is kept at values above at least 40%.

22995 (DOE/ER/60493—1-Vol.2, pp 650-654) **Low relative humidity and eye, nose, throat and skin irritation.** Arundel, A.; Collett, C.; Sterling, E.; Steeves, J. (Simon Fraser Univ., Burnaby, British Columbia). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The prevalence of eye, nose, throat and skin irritation in four office buildings was compared with the respondent's perception of humidity and the estimated indoor relative humidity (RH). Though respondents reporting symptoms believed that the RH was too low, there were few significant associations between symptom prevalence and RH.

22996 (DOE/ER/60493—1-Vol.2, pp 717-721) **Characterization of aeroallergen concentrations in indoor and outdoor microenvironments.** Stock, T.H.; Morandi, M.T. (Univ. of Texas School of Public Health, Houston). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Relatively little is known about indoor and outdoor microenvironmental concentrations of aeroallergens, or about the relationships between them. Consecutive 12-hour samples of airborne pollens and spores were collected simultaneously at two fixed site ambient air monitoring stations and inside and outside of each of 12 houses during the period June-October in Houston. Outdoor concentrations of pollen were spatially less heterogeneous than those of spores, and showed greater seasonal and diurnal variation. Indoor levels of both pollen and spores were uniformally lower than outdoor levels for all 12 air-conditioned homes, with indoor pollen counts on average 30% of outdoor values, and indoor spore counts on average 20% of outdoor values.

22997 (DOE/ER/60493—1-Vol.2, pp 732-737) **Colorimetric quantification of inhalant allergen sources in house dust.** Kniest, F.M. (Utrecht State Univ., Netherlands). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

House dust is a heterogeneous mixture containing many different inhalant allergenic substances. Colorimetric quantification of allergologically relevant mite infestation in house dust was performed by detection of a nitrogenous waste product, guanine. This was used to follow effects of house sanitation after acaricidal cleaning activities. Decrease in number of mites after acaricidal treatment can be measured quantitatively by the amounts of guanine present in house dust before and after treatment. Similarly, uric acid for insects and enzymes for molds could be used in the future. Checking on allergen producing organisms in the home showed quantitative relationships in dust between physiological activities and their excreted or secreted products. In the near future quick and easy method will allow housekeepers and physicians to monitor the content of allergen producing organisms in homes.

22998 (DOE/ER/60493—1-Vol.2, pp 738-741) **Indoor mite pollution and mite asthma.** Pauli, G.; Bessot, J.C.; Tenabene, A.; Kairouani, N. (Universite Louis Pasteur, Strasbourg, France). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The authors applied the Acarex test (a colorimetric assessment of guanine in mite excreta) to evaluate the presence of mite residues in altitude, in homes where Dpt sensitized patients had exacerbated symptoms, in a country where no mite counts had ever been performed. Out of 32 house dust samples obtained from high altitude (Chamonix Valley, St. Moritz, Ifrane), 23 were completely negative and 7 were slightly positive. In 12 houses, the guanine contents from homes where allergic symptoms occurred, were significantly higher than in 12 other homes where these patients were symptom free. Out of 31 houses of Dpt allergic patients living in Morocco, 2/3 were rich in mite residues.

22999 (DOE/ER/60493—1-Vol.2, pp 742-746) **Sources of pollution of indoor air by mite allergen containing house dust.** Bischoff, E. (Gesellschaft fuer Hausbiologische Forschung mbH, Mainz, Germany, F.R.). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The present report deals with field studies in the homes of people sensitized to house dust mites. Dust samples are examined by the assessment of the guanine-content in order to determine the sources of air pollution by mite excrement. After treatment with aqueous acaricides the decrease of the excrement-content is assessed, the aim being elimination of allergens for allergic people in their own homes.

23000 (DOE/ER/60493—1-Vol.2, pp 747-752) **Towards hygienic standards for the allergenicity of the indoor environment.** van Bronswijk, J.E.M.H. (Utrecht State Univ., Netherlands). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Public buildings should not present unacceptable risks, including allergies, for citizens. Also individual homes of allergic patients need a measure for allergenicity. Relating safe levels to vacuum cleaner dust, opens the possibility for layman to monitor. A maximal allowable concentration of mite products could be set provisionally at 0.6 mg guanine/g dust. Investigations on fungal problems focus usually on spores/m3 indoor air. A rough estimation and recalculation on extractable settled dust arrives at 8 million permissible fungal diaspores/g dust. In case of allergen sources that are larger in size (pets, cockroaches etc.) complete absence is considered to be the only sensible state. With immunological and biochemical techniques micro quantities of their products are detectable, but a hygienic standard for these sources may not yet be formulated.

23001 (DOE/ER/60493—1-Vol.2, pp 755-758) **Protein and amino acid (allergens).** Dave, J.M.; Anwikar, A.K. (Jawaharlal Nehru Univ., New Delhi, India). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Two homes, one masonry one and another village thatched hut are studied for total particulates mite count and protein content as allergens. The SPM variations and levels are only marginally different in total average and seasonal variations. But mite counts and protein counts are twice as high in the hut, indicating a larger concentration of mite, fungus, spores, pollens, and insect droppings etc. This means the hut has a higher potential for allergic reactions, but it was not possible to determine them due to a radically different health status.

23002 (DOE/ER/60493—1-Vol.2, pp 759-762) **Humoral immune responses in hypersensitivity pneumonitis.** Dewair, M. (Biochemica Pharmazeutika, Muenster, Germany, F.R.). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Chronic inhalation, in poorly ventilated places of organic materials may lead, in susceptible individuals to Hypersensitivity Pneumonitis (HP). Different terms of HP are used depending on the type of inhaled material. Thus, Farmer's Lung (FL) and Humidifier Lung (HL) diseases are two types of HP caused by exposure to moldy hay and humidifier air (aerosol) respectively. HP-symptoms are usually accompanied by circulating antibodies to the inhaled organic materials (antigens). Quantitative and qualitative analyses of these antibodies may give valuable information for diagnosis and prevention. Precipitating antibodies to microbial antigens, found in particles of moldy hay and to antigens found in humidifier waters are implicated in the induction and exacerbation of HP-symptoms. Since exposed and healthy people may also have these antibodies the difference between patients and their healthy cohorts may be in the magnitude and specificities - rather than in presence or absence of antibodies. Exact analytical methods may, therefore, help to differentiate between pathological and normal immune responses and to warn against development of HP in exposed persons. Using Protein A Radio Allergo Sorbent Test (PA-RAST) sera of FL-patients were found to contain high titre IgG antibodies to Aspergillus fumigatus (Af), a fungus known to grow in moldy hay.

23003 (DOE/ER/60493—1-Vol.2, pp 763-767) **Aeroallergens in New York inner-city apartments.** Goldstein, I.F.; Reed, C.E.; Swanson, M.C. (Columbia Univ. School of Public Health, New York, NY). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The results of two years' intensive monitoring of levels of aeroallergens prevailing indoors in inner-city homes of New York City are reported in this study. The aeroallergens are: cockroach, alternaria, house dust mite, cat and mouse urine. Our study population is mostly non-white, of low socioeconomic status, and has a 3-4-fold prevalence of asthma compared to the US population as a whole. Aeroallergens were sampled using a high volume air sampling device and assayed by the mini-RAST inhibition procedure. Monitoring has identified very high levels of cockroach, house dust mite, and alternaria allergens, all of which are known to provoke asthma symptoms in sensitive subjects. Levels of aeroallergens obtained in New York City are compared with those obtained in New Orleans, Louisiana and Rochester, Minnesota.

23004 (DOE/ER/60493—1-Vol.2, pp 777-780) **Allergies to molds caused by fungal spores in air-conditioning-plants.** Schata, M.; Jorde, W.; Elixmann, J.H.; Linskens, H.F. (Asthma-Krankenhaus der Kamillianer, Moenchengladbach, Germany, F.R.). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Thirty-eight percent of all allergic diseases in the Federal Republic of Germany are caused by sensitizations to molds. One typical source for mold exposure is the air conditioning plant. Peoples suffering from various symptoms in air-conditioned rooms show often sensitizations to molds which can be isolated out of the air conditioning plants. By specific challenge tests it could be shown, that fungal spores in air condition plants can evoke allergic symptoms. Hyposensitization is the specific therapy for those allergic illnesses. More than 70% of the so treated patients could live and work again in air-conditioned rooms without developing specific symptoms.

23005 (DOE/ER/60493—1-Vol.3, pp 404-408) **Draft and turbulence.** Fanger, P.O.; Melikow, A.K.; Hanzawa, H. (Technical Univ. of Denmark, Lyngby). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The impact of turbulence intensity on man's sensation of draft was investigated. Fifty subjects, dressed to obtain a neutral thermal sensation, were in three experiments exposed to air flow with low (Tu $<$ 12%), medium (20% $<$ Tu $<$ 35%) and high (Tu $>$ 55%) turbulence intensity (Tu). In each experiment subjects were sedentary and exposed to six mean air velocities ranging from 0.05 m/s to 0.40 m/s. The air temperature was kept constant at 23°C. They were asked whether and where they felt air movement and whether or not it felt uncomfortable. The percentage of subjects dissatisfied due to draft as a function of the mean velocity and the turbulence intensity has been found. The turbulence intensity had a significant impact on the perception of draft.

23006 (DOE/ER/60493—1-Vol.3, pp 414-418) **Experimental study on thermal sensation of human body in naturally ventilated rooms.** Sakakibara, N.; Ishii, A.; Katayama, T.; Tsutsumi, J.; Nishida, M. (Oita Univ., Japan). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The authors conducted the experiments on the effect of cross-ventilation on thermal sensation of people in dwelling units from June through August in two years. Comfort is highly related to air flow sensation. Speed, strength and fluctuation sensations of air flow have high correlation with each other and air flow sensation of the whole body. Women are more sensitive to thermal sensation and change their sensation votes more correspondingly to air velocity than men.

23007 (DOE/ER/60493—1-Vol.3, pp 419-423) **Occupant acceptance of air motion and asymmetric radiation in neutral and cool environments.** Berglund, L.G.; Fobelets, A.P. (Yale Univ., New Haven, CT). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Subjective responses were studied from 50 subjects wearing winter clothing (0.86 clo) to two-hour-long exposures of winter indoor conditions that included air speeds between 0.05 m/s and 0.5 m/s and radiant temperature asymmetries from a cold wall of 0 to 20 K. The experimentally determined preferred temperatures increased with air speed. The low mean radiant temperatures from the cold wall were compensated for by increased air temperatures that maintained the operative temperature constant at a given air speed. It was found that radiant temperature asymmetries of 10 K or less did not affect acceptability. Increasing radiant temperature asymmetry to 18 K at neutral conditions decreased thermal acceptability by 7%. The level of acceptance of the environment at preferred temperatures was unaffected by air speeds of 0.25 m/s or less.

23008 (DOE/ER/60493—1-Vol.3, pp 424-428) **Effects of the hot humid conditions on physiological indices of young people in housing areas in Vietnam.** Phong, D.N. (Hanoi Medical School, Vietnam). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Vietnam is situated in a hot humid climate, especially in summer. The hot weather creates unpleasant stuffy and sultry feelings for people. Our study was conducted on the changes of biological indices of the young people in hot humid conditions. In brief, this paper is meant to give answers to 2 problems: the endurance limit of the human body in hot humid conditions of the housing areas with lower-most wind velocities; and the indications of human adaptation to hot humid conditions and an assessment of the differences between the Vietnamese adaptability, if any, with overseas people and on this basis, initial suggestions on scientific grounds will be made on construction of summer facilities for residential areas in Vietnam.

23009 (DOE/ER/60493—1-Vol.4, pp 79-90) **Environmental tobacco smoke: a public health issue.** Lebowitz, M.D. (Univ. of Arizona, Tucson). 1987. NTIS, PC A 07. Order Number DE88004516/JAW. (CONF-870853—Vol.4).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The health effects of passive smoking (ETS) is now accepted in the perception of both the public and experts. ETS is now a public health issue and a legal, legislative issue. Although there are scientific issues still to be resolved, public perception and action are foremost in preventive approaches to the problem. Public policy has focused on legislative control. Further strategies will be needed, as public health history has shown that personal practices, including active smoking, are the most difficult to modify or control. The nature of the problem, and its context should be explored to reach the goals of appropriate control and public health action.

23010 **(PB—88-132881/XAB) Household solvent products: a national usage survey. Final report, October 1984-July 1987.** Eisenhower, D. (Battelle Columbus Div., OH (USA)). Jul 1987. 590p. NTIS, PC A25/MF A01.

See also PB—88-132899.

This study was conducted to provide usage information on 32 categories of common household and automotive products which were thought to contain methylene chloride or its substitutes. Respondents were selected using a random-digit dialing procedure, were contacted by telephone to get their consent and address, and were then sent a mail questionnaire which included product pictures. Nonrespondents were followed up with a telephone interview. The main objective was to acquire usage statistics for each product that can be used to calculate exposure assessments. These usage statistics included frequency, duration and amount of use, location of use, brand names used, and protective measures undertaken while using the product. Some major findings follow. Respondents used an average of seven of the 32 products in their lifetime and five during the last year. Contact cements, superglues and spray adhesives were used most frequently and brake quieters/cleaners, gasket removers and transmission cleaners were used least frequently. Duration of use was longest for paint removers/strippers, adhesive removers and wood stains, varnishes and finishes, and duration was shortest for ignition/wire dryers, spray shoe polish, and typewriter correction fluid. Most respondents reported having a window or door open but did not have a fan on while using products, and most reported that they read directions on the product labels before use. Finally, usage of the products decreases with increasing age.

23011 **(PB—88-132899/XAB) Household solvent products: a shelf survey with laboratory analysis. Final report, October 1984-July 1987.** Maklan, D.M.; Steele, D.H.; Dietz, S.K.; Brown, G.L.; Fallah, S. (Battelle Columbus Div., OH (USA)). Jul 1987. 217p. NTIS, PC A10/MF A01.

See also PB—88-132881.

This study was conducted to provide information on the incidence and concentration of six chlorocarbons in common household products. The objectives of the study were to: (1) determine which categories of consumer products contain the chemical methylene chloride and/or five potential substitute solvents (1,1,1-trichloroethane, trichloroethylene, tetrachloroethylene, carbon tetrachloride, and 1,1,2-trichlorotrifluoroethane); and (2) analyze brands representing each product category to determine the concentration of these chemicals in household products. A national sample of household products was selected and laboratory tested to determine the incidence and concentration of the six target chlorocarbons. The following are some of the major findings. Fifty-eight percent of the 67 product categories had at least one brand test positive for one or more of the target analytes. Thirty-four percent of the 1026 brands tested positive for at least one of the six target chlorocarbons. Thirty-four percent of the brands tested positive for methylene chloride, 14% tested positive for 1,1,1-trichloroethane, and less than 4% of the brands were positive on any of the remaining four chlorocarbons. The concentration of analyte varied considerably between brands of the same product category. Only 56% of the brands with chlorocarbons were so labeled.

5530 Agriculture And Food Technology

REFER ALSO TO CITATION(S) 21319, 21706, 23079

23012 **(IAEA-R—3795-F) Distribution and metabolism of carbofuran in paddy rice. Final report for the period 1983 - 1987.** Szilvassy, L.; Dombovari, J. (Research Inst. for Irrigation, Szarvas (Hungary)). (International Atomic Energy Agency, Vienna (Austria)). Dec 1987. 21p. NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701738/JAW.

A study was conducted to evaluate slow release formulations of carbofuran in aquatic systems. Laboratory, greenhouse and field experiments in rice paddy were carried out to determine the behaviour and fate of the important systemic insecticide carbofuran after application of new formulations. The release rates into water and the residues in the plant and soil were determined. Metabolites were identified by gas chromatography/mass spectrometry. Carbon-14 labelled carbofuran was used for the experiments. The results showed that the cellulose based (hydroxyethyl-cellulose) formulations released the active ingredient carbofuran at a significantly slow rate, compared to commercial formulations, but that the concentration of carbofuran in water and plants was high enough to protect the plants against insects. Recovery of the applied insecticide in the rice paddy was only about 30%. Most of it was lost by evaporation, which could be confirmed in laboratory and glass house experiments. The radioactivity found in grain and straw was 0.03% and 0.2%, respectively. The distribution of carbofuran in soil at different layers was: 0-5 cm: 17%, 5-15 cm: 7%, 15-25 cm: 4%, 25-40 cm: 2%. Less than 10% of the total radioactivity could be extracted from plants (Soxhlet extraction with acetonitrile and methanol); thus, most of the carbofuran was metabolized and bound to the plant/grain constituents. It was concluded that by using dif-

ferent natural polymers, and some combinations of them for formulations, release rates of carbofuran in aquatic systems could be slowed down. Simple formulation procedures and low prices would also permit application of formulations in less developed countries. 5 refs, 6 figs, 4 tabs.

23013 (INIS-mf—10846, pp 7) **Mutagenity of gamma-irradiated diet for mice.** Rupova, I.; Tencheva, S.; Katsareva, Ts. (Meditsinska Akademiya, Sofia, Bulgaria). Nov 1984. (In Bulgarian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

23014 (INIS-mf—10846, pp 65) **Long-term investigation of the harmlessness of gamma-irradiated combined forage for mice.** Tencheva, S.; Katsareva, Ts. (Meditsinska Akademiya, Sofia, Bulgaria). Nov 1984. (In Bulgarian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

23015 (INIS-mf—11043) **Studies of radioinduced mutations in sorghum grain: 1. Comparison of phenotypic variability obtained through hybridation and mutagenesis of F/sub 2/ and M/sub 2/ populations; 2. Agronomical and physiotechnical characterization of mutants lines in the original collection and in the advanced lines of the Chapingo Postgraduate college.** Parra Negrete, L.A. (Colegio de Post Graduados, Mexico City. Centro Genetica). 1986. 78p. (In Spanish). NTIS (US Sales Only), PC A05/MF A01. Order Number TI88701747/JAW.

Genetic inprovement of cultivated plants consists essentially of three phases (1) generation of genetic variability (2) selection of genotypes and (3) evaluation of selected genotypes. Hybridization and spontaneous or induced mutations are, responsible for the generation of and increase in genetic vegetative variability. Accordingly, such methods are used alternatively in local programs for plant improvement either for introducing improved genotypes or as sources of germplasma. This thesis is based on two experiments of mutations induced by cobalt 60 ionizing radiation while using distinct materials and methods presented in two parts, the first section analyze the mutation variability and the second the evaluation of mutant lines.

23016 (PAEC(C)II-A—86010) **Study of man made radioactivity baseline in dietary materials.** de la Paz, L.; Estacio, J.; Palattao, M.V.; Anden, A. (Philippine Atomic Energy Commission, Diliman, Quezon City). 1986. 14p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701214/JAW.

This paper describes the radioactivity baseline from literature data coming from various countries where data are available. 1979-1985 were chosen as the baseline years for the following: milk (fresh and powdered), meat and meat products, cereals, fruits, coffee and tea, fish and vegetables. Pre- and post-Chernobyl baseline data are given. (ELC). 21 figs; 17 refs.

23017 (PB—88-856372/XAB) **Food and grain preservation through irradiation. January 1970-January 1988 (citations from the NTIS data base). Report for January 1970-January 1988.** (National Technical Information Service, Springfield, VA (USA)). Jan 1988. 133p. NTIS PC N01/MF N01.

Supersedes PB—86-872256.

This bibliography contains citations concerning the principles, methods, and results of using ionized irradiation to preserve grains and foods through reduction of spoilage and infestation. The citations cover irradiation chemistry as it affects food wholesomeness, nutrition, and changes in food value. Irradiation methods include sources of irradiation, primarily gamma rays, and dosage for specific foods. Many articles reference public health and safety, studies of effect of irradiated food on laboratory animals, and associated standards and legislation. (This updated bibliography contains 325 citations, 35 of which are new entries to the previous edition.)

23018 (PINSTECH/HPD—124) **Radiological analysis of lunch served at PINSTECH cafeteria.** Haq, E.U.; Mubarak, M.A.; Faruq, M.U.; Aziz, A.; Perveen, N.; Orfi, S.D. (Pakistan Inst. of Nuclear Science and Technology, Rawalpindi. Health Physics Div.). Jun 1986. 22p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701218/JAW.

Radiometric analysis of lunch served at PINSTECH cafeteria was carried out during the period from 1976 to 1984 by NaI (TI) scintillation detector, high resolution Ge(Li) detector gamma spectrometry system and low level beta counter. K-40 and Sr-90 were the most prominent radionuclides normally detected in all the lunch samples. Other radionuclides were below the measurement limits of our counting set up. Assuming 5 days a week and 50 weeks a year it can be safely stated that intake of K-40 and Sr-90 through LUNCH taken at PINSTECH cafeteria remains well below respective ALI's of these radionuclides.

56 BIOMEDICAL SCIENCES, APPLIED STUDIES

5601 Radiation Effects

REFER ALSO TO CITATION(S) 22263, 22553

23019 (AD-A—187376/9/XAB) **Different small, acid-soluble proteins of the alpha/beta type have interchangeable roles in the heat and uv (ultraviolet) radiation resistance of Bacillus subtilis spores.** Mason, J.M.; Setlow, P. (Connecticut Univ. Health Center, Farmington (USA). Dept. of Biochemistry). Aug 1987. 6p. NTIS, PC A02/MF A01.

Pub. in Jnl. of Bacteriology, Vol. 169, No. 8, 3633-3637(1987).

Spores of Bacillus subtilis strains which carry deletion mutations in one gene (sspA) or two genes (sspA and sspB) which code for major alpha/beta-type small, acid-soluble spore proteins (SASP) are known to be much more sensitive to heat and UV radiation than wild-type spores. This heat- and UV-sensitive phenotype was cured completely or in part by introduction into these mutant strains of (i) one or more copies of the sspA or sspB genes themselves; (ii) multiple copies of the B. subtilis sspD gene, which codes for a minor alpha/beta-type SASP; or (iii) multiple copies of the SASP-C genes, which codes for a major alpha/beta-type SASP of Bacillus megaterium. These findings suggest that alpha-beta-type SASP play interchangeable roles in the heat and UV radiation resistance of bacterial spores.

23020 (AD-A—187498/1/XAB) **Application of new technologies to radiation biodosimetry in mammalian systems. Volume 2. Final report, January-December 1985.** Sutherland, R.M.; Lord, E.M.; Keng, P.C. (Rochester Univ., NY (USA). School of Medicine and Dentistry). Aug 1987. 24p. NTIS, PC A03/MF A01.

See also report dated February 1986, AD-A168 176.

Various procedures, including flow-cytometry analysis, premature chromosome condensation (PCC) techniques, deoxyribonucleic acid (DNA) damage and repair kinetics, amd high-resolution microscopic image analysis (Cell Analyzer System), were used to determine radiation damage produced by low doses of ^{137}Cs. Peripheral lymphocytes isolated from whole-body irradiated mice were stained with Ig and Thy-1.2 immunofluorescence antibodies and analyzed with cytometry to determine the cell number and changes in subpopulations (T- and B-cells) as a function of post-irradiation time. The results indicated a dose-dependent decrease of lymphocyte numbers during the period of 5-day post-irradiation time. Cell-survival curves constructed from different subpopulations of lymphocytes in the dose range of 0-2 Gy showed a linear relationship between radiation dose and log surviving cell number in different subpopulations of lymphocytes, indicating the radiation-sensitive nature of the lymphocytes. The DNA damage and repair

kinetics were measured from in-vitro and in-vivo mouse lymphocytes, Chinese hamster ovary (CHO) cells, and human squamous carcinoma A431 cells to compare the cellular radiosensitivity with DNA repair capacity. Quantitativity similar amounts of initial DNA damage were produced among the different kinds of cells. However, the repair of DNA strand breaks was significantly faster in A431 cells than CHO and lymphocytes.

23021 **(AD-A—187603/6/XAB) Drug development against nuclear and chemical threats: development of new prophylactic radioprotective agents. Final annual report, 15 June 1985-14 August 1987.** Carroll, F.I.; Abraham, P. (Research Triangle Inst., Research Triangle Park, NC (USA)). Aug 1987. 81p. NTIS, PC A05/MF A01.

This study were is concerned with the preparation of analogs of (WR2721) with modifications in the terminal amine function as potentially new prophylactic radioprotective agents. General methods were developed for the synthesis of WR2721 analogs that possess amide (-C(=O)NHR), thioamide (-C(=S)NHR) and amidine (-C(=NX)NH_3) terminal residues. In addition, methods were developed for the synthesis of 2-thioxo-3-thiazolidines and 5,6-dihydro-1,2,4,3(4H)-dithiazinethiones as new sulfur masked analogs of (WR1065). During the contract period, a total of twenty-eight (28) target compounds were prepared and submitted for radioprotector screening. No test data is available at this time.

23022 **(BMU—1987-164) Investigation of the radiation-induced changes of electrophoretic mobility of human erythrocytes.** Butkowskyj-Walkiw, T.; Spiegelberg, A.; Boegl, W. (Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany, F.R.)). Jun 1987. 61p. (In German). GRM Werbeberatung - Werbemittlung - PR, Eggenstein-Leopoldshafen, Germany, F.R.

Schriftenreihe Reaktorsicherheit und Strahlenschutz. Ergebnisberichte, Untersuchungen, Studien, Gutachten.

According to the results that have been published up to now, the erythrocytes' behaviour might be used to assess the absorbed dose of radiation. However, these results do not provide detailed information about the extent of the effect. This is due among others, to the measuring methods applied, some of which are associated with an important measuring error. In order to avoid this problem, free-flow electrophoresis was used, which is a rapid, mild and highly efficient method. After in vitro irradiation of human erythrocytes at a dose of 3 Gy and subsequent fixation using KMnO/sub 4/, the electrophoretic behaviour of the cell membrane was found to change by a rate of up to 6%. In order to answer the question of whether this method would be suitable as a biochemical indicator, we conducted not only in vitro experiments but also experiments involving in vivo irradiation of human erythrocytes. For this purpose we collected blood from radiation therapy patients. The results of this study showed that electrophoretic changes by up to 6% may be observed within a period up to 2 days following exposure to ionizing radiation. The suitability of this biochemical indicator system for the detection of radiation is, however, complicated by variations in the EPM of non-irradiated erythrocytes.

23023 **(CEA-R—5402) Evolution of microbial activity in a Mediterranean ecosystem submitted to chronic gamma irradiation. Investigation of nitrogen transfer with isotopic tracers.** Castet, R. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France)). Jul 1987. 105p. (In French). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88752143/JAW.

A Mediterranean ecosystem located on the site of Cadarache (France) has been experimentally by irradiated over the past fifteen years. The potential effects of ionizing radiations for different doses of its ecological system has been studied. The objective of the work was to demonstrate the level of soil microbial population and its activity. Chronic exposures reduced the biomass and the dehydrogenase activity by a factor of 50% and increased the amount of nitrate in the soil. To measure the direct impact of irradiations on soil microorganisms, we have irradiated soil sample in laboratory at 0.1; 0.5; 1 kGy, and observed its evolution during a period of six weeks thereafter. We have a reduction of the dehydrogenase activity and an increase of nitrate being proportionaly to the dose delivered. Using nitrogen labelled, we state that this high rate of nitrate production is due to an inhibition of the organization of this form of nitrogen. Conversely, the ammonification and the nitrification are not affected. Also, for anaerobic conditions created by glucose, the nitrate labelled (15N) permitted us to show that in untreated soil, 45% of nitrate was reduced to nitrogen gas by denitrification and 24% of nitrate was reduced to ammonium by dissimilation in the irradiated soil. These experiments show that gamma irradiations are of great interest for studying soil microorganisms. As of now, very little is known on the effects of this kind of stress for attention and need to be pursued on such ecosystems. Further investigations call.

23024 **(CONF-830951—) Life-span radiation effects studies in animals: What can they tell us: DOE symposium series 58.** Thompson, R.C.; Mahaffey, J.A. (eds.). (Pacific Northwest Lab., Richland, WA (USA)). Oct 1986. Contract AC06-76RL01830. 742p. NTIS, PC A99; 3; GPO Dep. Order Number TI87000490/JAW.

From 22. Hanford life sciences symposium - life-span radiation effects studies in animals - what can they tell us; Richland, WA, USA (27 Sep 1983).

Individual papers are processed separately for the data base. Authors describe research programs at several major research laboratories. Various aspects of numerous experiments are described. Data from the effects of low-dose irradiation experiments involving animals are extrapolated to man. (TEM)

23025 (CONF-830951—, pp 1-13) **Life-span radiation effects studies in prenatally and postnatally exposed beagle dogs at Colorado State University.** Benjamin, S.A.; Lee, A.C.; Angleton, G.M.; Jaenke, R.S.; Saunders, W.J.; Miller, G.K.; Brewster, R.D. (Colorado State Univ., Fort Collins (USA)). Oct 1986. NTIS, PC A99. Order Number TI87000490/JAW.

From 22. Hanford life sciences symposium - life-span radiation effects studies in animals - what can they tell us; Richland, WA, USA (27 Sep 1983).

The lifetime hazards associated with exposure to ionizing radiation during development are studied in 1680 beagle dogs given whole-body exposures to ^{60}Co gamma radiation. Eight groups of 120 dogs each received 20-R or 100-R exposures at 8, 28, or 55 days postcoitus (dpc) or at 2 days postpartum (dpp). In addition, exposures of 100 R were given to 120 dogs at 70 dpp and to 240 dogs at 365 dpp. An additional 360 dogs were sham exposed. Smaller groups of dogs were used to identify organs and tissues of particular sensitivity to radiation injury during development and to evaluate mechanisms of radiation injury. The research is concerned primarily with evaluating the role of age at exposure as a factor influencing response to radiation injury. As of December 31, 1982, of the 1680 dogs, 1058 were dead. Survivors ranged from 9.9 to 15 years of age. Through 10 years of age, no differences in survival were evident in any exposure groups. A variety of clinical, pathophysiologic, and pathologic responses have been studied. Irradiation during development has been found to be associated with abnormalities of skeletal, dental, and central nervous system development. Irradiation during ocular development has induced dysplastic and atrophic retinal lesions. Perinatal irradiation of the kidney has resulted in dysplasia, and, in animals receiving higher doses, significant chronic renal disease. The thymus gland, particularly thymic epithelium, has been found to be highly radiosensitive during fetal development.

23026 (CONF-830951—, pp 14-31) **Chronic radiation injury with mice and dogs exposed to external whole-body irradiation at the Argonne National Laboratory.** Grahn, D.; Fritz, T.E. (Argonne National Lab., IL (USA)). Oct 1986. NTIS, PC A99. Order Number TI87000490/JAW. Contract W-31109-ENG-38.

From 22. Hanford life sciences symposium - life-span radiation effects studies in animals - what can they tell us; Richland, WA, USA (27 Sep 1983).

This document describes studies on chronic radiation injury in experimental animals and the extrapolation of derived injury parameters to man. Most of the large studies have used mice given single, weekly, or continuous exposure to cobalt-60 gamma rays, or, more recently, single or weekly exposure to fission neutrons from the JANUS reactor. Primary measures of injury have been life

shortening and the associated major pathological changes, particularly neoplastic diseases. Recent and ongoing studies compare the effects of extremely low neutron exposures with gamma irradiations delivered as a single dose or in 60 equal weekly increments. Total neutron doses range from 1 to 40 rads; gamma-ray doses range from 22.5 to 600 rads. Selected genetic studies are performed concurrently to provide a nearly complete matrix of somatic and genetic effects of these low exposures. Studies with the beagle have complemented those with mice and have shown a strong parallelism in the responses of the two species. Present exposures are at 0.3, 0.75, and 1.88 rads per day of continuous gamma irradiation to test a model for the prediction of life shortening in man which has evolved from Argonne's long-term studies. The dog offers the opportunity for longitudinal clinical evaluations that are not possible in the mouse, to develop a broader view of the neoplastic disease spectrum, and to study the mechanisms of radiation induction of leukemia. Diverse statistical approaches have been used to measure excess risk, dose-response functions, and rates of injury and repair. Actuarial statistical methods have been favored since they permit a more direct means of extrapolation to man. 50 refs., 4 figs.

23027 (CONF-830951—, pp 32-52) **DOE life-span radiation effects studies in experimental animals at University of Utah Division of Radiobiology.** Wrenn, M.E.; Taylor, G.N.; Stevens, W.; Mays, C.W.; Jee, W.S.S.; Lloyd, R.D.; Atherton, D.R.; Bruenger, F.W.; Miller, S.C.; Smith, J.M. (Univ. of Utah, Salt Lake City (USA)). Oct 1986. NTIS, PC A99. Order Number TI87000490/JAW. Contract AC02-76EV00119.

From 22. Hanford life sciences symposium - life-span radiation effects studies in animals - what can they tell us; Richland, WA, USA (27 Sep 1983).

The Radiobiology Laboratory at the University of Utah compared the long-term biological effects of ^{226}Ra and ^{239}Pu in adult beagles. The program includes the investigation of other radionuclides. More recently, groups of juvenile and aged beagles were added to the study to investigate the influence of age at exposure. These studies involved single intravenous injection of radionuclides to small groups of beagles, in graded doses from levels at which no effects were expected up to levels where a 100% incidence of bone tumors was sometimes found. Some of the principal effects were bone tumors, fractures, and other skeletal alterations observed radiographically and histologically; emphasis was placed on the detection of precancerous changes, hematological changes, and changes related to aging. Emphasis was also placed on metabolic and autoradiographic studies necessary for good radiation dosimetry.

23028 (CONF-830951—, pp 53-65) **Lifetime radiation effects research in animals: An overview of the status and philosophy of studies at University of California-Davis Laboratory for Energy-Related Health Research.** Goldman, M.; Rosenblatt, L.S.; Book, S.A. (Univ. of California-Davis, Davis (USA)). Oct 1986. NTIS, PC A99. Order Number TI87000490/JAW. Contract AC03-76SF00472.

From 22. Hanford life sciences symposium - life-span radiation effects studies in animals - what can they tell us; Richland, WA, USA (27 Sep 1983).

Studies on the life-shortening and carcinogenic effects of internal emitters and external irradiation have been conducted at the Laboratory for Energy-Related Health Research for over three decades. Our principal animal model has been the beagle dog. The beagle's tissue sensitivity, metabolic and dosimetric characteristics, pathologic responses, and aging changes give it relevance for the assessment of radiation risks in humans. Although our results confirm the existence of an amelioration of effects at low doses and low dose rates (the dose-rate effectiveness factor), the manifestation of the amelioration may vary. For example, with x-irradiation higher exposures appeared to decrease latency but did not alter the incidence of mammary cancer, whereas with the bone-seeking radionuclides, ^{90}Sr and ^{226}Ra, higher doses decreased the latency and increased the incidence of osteosarcomas. Radiation-induced leukemias were seen only with high doses at high dose rates but only from ^{90}Sr and from chronic exposures to ^{60}Co, mainly in dogs exposed beginning in utero. Most of the radiation-induced life shortening in dogs exposed to internal emitters appears attributable to an increased cancer risk, but this is not necessarily the case for x-irradiated dogs.

23029 (CONF-830951—, pp 66-73) **DOE life-span radiation effects studies at Pacific Northwest Laboratory.** Thompson, R.C.; Cross, F.T.; Dagle, G.E.; Park, J.F.; Sanders, C.L. Oct 1986. NTIS, PC A99. Order Number TI87000490/JAW. Contract AC06-76RL01830.

From 22. Hanford life sciences symposium - life-span radiation effects studies in animals - what can they tell us; Richland, WA, USA (27 Sep 1983).

Major life-span radiation effects studies at Pacific Northwest Laboratory fall into three categories: (1) studies with beagle dogs exposed to plutonium compounds via a single inhalation; (2) studies with dogs and rats exposed chronically via inhalation to various combinations and concentrations of radon, radon daughters, and other components of uranium mine atmospheres; and (3) a study in which rats are exposed via single inhalation, in very large numbers, to very low concentrations of $^{239}PuO_2$. Exposure of beagles currently on study was initiated in 1970 with $^{239}PuO_2$, in 1973 with $^{238}PuO_2$, and in 1976 with $^{239}Pu(NO_3)_4$. These experiments involve more than 500 animals, many of them still alive. Experiments seeking to explain the increased incidence of lung cancer in uranium miners have been in progress since 1966. Present emphasis is on studies with rats, in an attempt to define dose-effect relationships at the lowest feasible radon-daughter exposure levels. Our very-low-level experiment with inhaled $^{239}PuO_2$ in rats, with exposures still under way, includes 1000 rats in the control group and 1000 rats in the lowest-exposure group, where life-span lung doses of <5 rads are anticipated.

23030 (CONF-830951—, pp 74-96) **Lovelace ITRI studies on the toxicity of inhaled radionuclides in beagle dogs.** McClellan, R.O.; Boecker, B.B.; Hahn, F.F.; Muggenburg, B.A. (Lovelace Biomedical and Environmental Research Institute, Albuquerque, NM (USA)). Oct 1986. NTIS, PC A99. Order Number TI87000490/JAW. Contract AC04-76EV01013.

From 22. Hanford life sciences symposium - life-span radiation effects studies in animals - what can they tell us; Richland, WA, USA (27 Sep 1983).

This paper reviews 19 studies conducted by the Lovelace ITRI on the toxicity of inhaled radionuclides in beagle dogs. These studies provide information to estimate potential health effects in accidentally exposed people. Specific radionuclides (^{90}Sr, ^{90}Y, ^{91}Y, ^{137}Cs, ^{144}Ce, ^{238}Pu, and ^{239}Pu), chemical forms, and particle sizes were selected for study because they are abundant in nuclear operations and deliver a wide range of radiation dose patterns. Depending upon the aerosol, one or more of the following organs or tissues received the significant irradiation: lung, nasal cavity, lung-associated lymph nodes, whole body, liver, or skeleton, with the radiation dose delivered over durations of time ranging from a few days to several years. In eight studies monodisperse particles of either $^{238}PuO_2$ or $^{239}PuO_2$ were used to evaluate the influence of particle number and total dose on lung cancer induction. Most studies involved single, brief exposures of young adult dogs, but two studies used immature dogs, two used aged dogs, and two studies involved repeated brief exposures. For each aerosol two types of studies were conducted. One was used to evaluate the time course of retention of radioactivity in various tissues of the body for calculating radiation doses. The second was used to determine health effects in animals exposed to achieve different initial lung burdens and observed for the remainder of their life spans. Initial lung burdens were selected to produce early morbidity and mortality at the highest levels and an excess of late-occurring diseases such as cancer at the lowest levels. The latter dogs have had an excess incidence of cancer, especially of the lung, lung-associated lymph nodes, nasal cavity, skeleton, and liver. Relationships between radiation doses to various tissues and effects have been evaluated for individual studies.

23031 (CONF-830951—, pp 107-115) **Longevity of irradiated burros.** Lushbaugh, C.C.; Brown, D.G.; Frome, E.L. (Oak Ridge Associated Universities, TN (USA); Cedar Bluff Animal Clinic, Knoxville, TN (USA); Oak Ridge National Lab., TN (USA)). Oct 1986. NTIS, PC A99. Order Number TI87000490/JAW. Contract AC05-76OR00033.

From 22. Hanford life sciences symposium - life-span radiation effects studies in animals - what can they tell us; Richland, WA, USA (27 Sep 1983).

During the course of external radiation exposures of burros to establish a dose-response curve for acute mortality after total irradiation, some of the animals at the three lowest exposures to gamma photons survived. These groups of 10, 9, and 10 burros were exposed to 320, 425, and 545 R, respectively. There were 10 unirradiated controls. In 1953, 20 burros were exposed to 375 R (gamma) in 25-R/week increments without acute mortality and were added to the life-span study. In 1957, 33 burros were exposed to mixed neutron-gamma radiation from nuclear weapons, and 14 controls were added. The total number of irradiated burros in the study was increased to 88 by the addition of 6 animals irradiated with 180 rads of neutron and gamma radiation (4:1) in a Godiva-type reactor in 1959. In this experiment two acute deaths occurred which were not included in the analysis. In the first 4 years after the single gamma exposures, there were deaths from pancytopenia and thrombocytopenia, obviously related to radiation-induced bone-marrow damage. After that period, however, deaths were from common equine diseases; no death has resulted from a malignant neoplasm. Of the original 112 burros, 15 survive (10 irradiated and 5 controls). Survival curves determined for unirradiated and neutron-gamma- and gamma-irradiated burros showed significant differences. The mean survival times were: controls, 28 years; gamma irradiation only, 26 years; and neutron-gamma irradiation, 23 years. 3 refs., 4 figs., 1 tab.

23032 (CONF-830951—, pp 116-141) **Late effects of protracted whole-body irradiation of beagles by cobalt-60 gamma rays.** Fritz, T.E.; Seed, T.M.; Tolle, D.V.; Lombard, L.S. (Argonne National Lab., IL (USA)). Oct 1986. NTIS, PC A99. Order Number TI87000490/JAW. Contract W-31109-ENG-38.

From 22. Hanford life sciences symposium - life-span radiation effects studies in animals - what can they tell us; Richland, WA, USA (27 Sep 1983).

So that a stronger basis for extrapolation of low-level radiation effects to man can be provided, existing data from small laboratory animals are being supplemented by studies in a longer lived animal, the dog. Beagle dogs are exposed to continuous cobalt-60 irradiation either throughout life or until predetermined total doses are accumulated. The radiation-specific excess-mortality rate and associated causes of death will be related to both dose rate and total dose. The ongoing studies also emphasize the pathogenesis of myelogenous leukemia. At dose rates of 3.75 to 26.25 rads/day, given continuously, responses were consistent, highly dose-rate dependent, and limited primarily to the hematopoietic system. At rates as low as 0.3 rad/day, the hematopoietic system is still the limiting factor for survival, but below 3.75 rads/day present evidence suggests that the responses are independent of dose rate. Longitudinal studies of peripheral blood and bone marrow detected four preclinical phases of myelogenous leukemia. These phases were characterized by standard hematologic end points, ultrastructural features, in vitro cloning assays, and the acute radiation sensitivity of stem cells. Results suggest that an induced error-prone repair mechanism is the basis for the onset of radiation-induced myelogenous leukemia. Interim data from dogs given terminated exposures suggest that the types of tumors and times to death are different from controls but the numbers of tumors are not yet greater than in controls. 26 refs., 12 figs., 5 tabs.

23033 (CONF-830951—, pp 142-159) **Neoplasia in beagles that received whole-body irradiation during prenatal or postnatal development.** Benjamin, S.A.; Angleton, G.M.; Lee, A.C.; Saunders, W.J.; Miller, G.K.; Jaenke, R.S.; Brewster, R.D.; Long, R.I. (Colorado State Univ., Fort Collins (USA)). Oct 1986. NTIS, PC A99. Order Number TI87000490/JAW.

From 22. Hanford life sciences symposium - life-span radiation effects studies in animals - what can they tell us; Richland, WA, USA (27 Sep 1983).

Sensitivity to radiation carcinogenesis is being studied in 1680 beagle dogs that received whole-body ^{60}Co gamma radiation exposures during development. Eight treatment groups of 120 dogs each received 0.16 or 0.83 Gy at one of three prenatal (8, 28, or 55 days postcoitus) ages or at one postnatal (2 days postpartum) age. One treatment group of 120 dogs received 0.83 Gy as juveniles at 70 days postpartum, and one treatment group of 240 young adult dogs received 0.83 Gy at 365 days postpartum. Three-hundred-sixty control dogs were sham irradiated. Of the 1680 dogs, 1058 are dead. Approximately 25% of these deaths were related to malignant neoplasia. The age-related incidence of neoplasia is being evaluated. While the incidence of all neoplasms is being studied, particular emphasis is being placed on types of cancer with known susceptibility to induction by radiation such as those of breast, thyroid, and hematopoietic tissues. Neoplasms are classed as (1) incidental, i.e., those found at necropsy in dogs that died of an unrelated cause; (2) mortality independent, i.e., those seen in live dogs and removed surgically, or (3) fatal, i.e., those directly or indirectly responsible for death. Analyses of incidental tumors are done by a prevalence method, whereas analyses of mortality-independent and fatal tumors use an onset-rate or death-rate method. The results of these methods are then combined to give a composite age-related incidence of specific neoplasms. Analyses also are done on disease subgroups to attempt to delineate the effect of intercurrent disease on tumor incidence. The results of such analyses support the concept that age at exposure is an important factor in radiation carcinogenesis. 28 refs., 7 tabs.

23034 (CONF-830951—, pp 160-171) **Use of linear model analysis techniques in the evaluation of radiation effects on the life span of the beagle.** Angleton, G.M.; Lee, A.C.; Benjamin, S.A. (Colorado State Univ., Fort Collins (USA)). Oct 1986. NTIS, PC A99. Order Number TI87000490/JAW.

From 22. Hanford life sciences symposium - life-span radiation effects studies in animals - what can they tell us; Richland, WA, USA (27 Sep 1983).

The dependency of the beagle-dog life span on level of and age at exposure to ^{60}Co gamma radiation was analyzed by several techniques; one of these methods was linear model analysis. Beagles of both sexes were given single, bilateral exposures at 8, 28, or 55 days postcoitus (dpc) or at 2, 70, or 365 days postpartum (dpp). Dogs exposed at 8, 28, or 55 dpc or at 2 dpp received 0, 20, or 100 R, whereas those exposed at 70 or 365 dpp received 0 or 100 R. Beagles were designated initially either as sacrifice or as life-span animals. All deaths of life-span study animals were classified as spontaneous, hence for this group the mean age of death was a quantitative response that can be analyzed by linear model analysis techniques. Such analyses for each age group were performed, taking into account differences due to sex, linear and quadratic dependency on dose, and interaction between sex and dose. At this time most of the animals have reached 11 years of age. No significant effects of radiation on mean life span have been detected. 6 refs., 3 figs., 3 tabs.

23035 (CONF-830951—, pp 172-183) **Life-span shortening and disease incidence in male BALB/c and C57BL mice after single, fractionated d(50)-Be neutron or gamma exposure.** Maisin, J.R.; Gerber, G.B.; Wambersie, A.; Mattelin, G.; Lambiet-Collier, M.; Gueulette, J. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium); Univ. of Louvain at Woluwe, Brussels (Belgium)). Oct 1986. NTIS, PC A99. Order Number TI87000490/JAW.

From 22. Hanford life sciences symposium - life-span radiation effects studies in animals - what can they tell us; Richland, WA, USA (27 Sep 1983).

Life-span shortening and causes of death, ascertained by autopsy and histological examination at the time of spontaneous death, after single or fractionated x-ray, gamma, or d(50)-Be neutron irradiation, are being studied for two mouse strains (BALB/c and C57BL) with different disease characteristics. Fractionation schedules that have been implemented are x rays, four weekly exposures (C57BL); gamma rays, 10 daily exposures (BALB/c; and

neutrons, eight exposures at 3-h intervals (C57BL). The data are incomplete but suggest that the dependency of life shortening on dose is related to the types of effects induced by radiation and results in different functions, linear or sigmoid, for the two mouse strains. Fractionated gamma irradiation causes more tumors than single exposure, but, generally, this is a result of multiple tumors occurring in animals. The relative biological effectiveness (RBE) for life shortening for d(50)-Be neutrons as compared to gamma rays is on the order of 1 to 2 and is slightly greater for the C57BL than for the BALB/c strain. 18 refs., 2 figs., 3 tabs.

23036 (CONF-830951—, pp 184-192) **An experimental study of fission neutron carcinogenesis.** Morin, M.; Masse, R.; Lafuma, J. (CEA, Centre d'Etudes Nucleaires de Fontenay aux Roses (France)). Oct 1986. NTIS, PC A99. Order Number TI87000490/JAW.

From 22. Hanford life sciences symposium - life-span radiation effects studies in animals - what can they tell us; Richland, WA, USA (27 Sep 1983).

We previously investigated the dose-effect relationship for lung carcinomas in rats exposed to radon and daughters at doses ranging from 20 to 12,000 working-level months (WLM). For comparison of the carcinogenic effectiveness of neutrons, rats of the same strains were given doses from 0.01 to 8 Gy, and the dose-effect relationship was estimated for the same lung carcinomas. Other malignant and benign tumors from various organs were analyzed by using a classification similar to that used for man. The data obtained make it possible to relate frequency and time of observation to radiation dose for each type of cancer. The dose-effect relationship for the various types of radiation-induced cancers differs. The relative radiosensitivity of organs is therefore also apparently dose dependent. If effects from radon are taken as a reference, the carcinogenic effectiveness of neutrons in rats is higher than is reflected by the quality factor currently used for man. 7 refs., 8 tabs.

23037 (CONF-830951—, pp 193-218) **Neoplastic and other pathologic effects of fractionated fast neutrons or photons on the thorax and anterior abdomen of beagles.** Zook, B.C.; Bradley, E.W.; Casarett, G.W.; Rogers, C.C. (George Washington Univ. Medical Center, Washington, DC (USA); Univ. of Rochester Medical Center, NY (USA)). Oct 1986. NTIS, PC A99. Order Number TI87000490/JAW.

From 22. Hanford life sciences symposium - life-span radiation effects studies in animals - what can they tell us; Richland, WA, USA (27 Sep 1983).

Thirty-nine adult male beagle dogs received either fast-neutron or photon irradiation to the right hemithorax and right rostral abdomen. Twenty-four dogs (six per group) received fast neutrons (15 MeV) to total doses of 1000, 1500, 2250, or 3375 cGy in four fractions per week for six weeks. Fifteen dogs received 3000, 4500, or 6750 cGy of photons in an identical fractionation pattern. One photon-irradiated dog and 13 neutron-irradiated dogs died or were euthanatized because of hepatic and gastrointestinal disturbances 47 to 708 days after irradiation; 20 dogs died of other causes. These 34 dogs were necropsied and have been studied microscopically; the remaining five dogs are still alive seven years after irradiation. Neutron-induced lesions included hemorrhage, necrosis, fibrosis, and atrophy of the heart, liver, pancreas, pylorus, duodenum, and kidney. All lesions were associated with degenerative and occlusive vascular changes including coronary arteriosclerosis. The relative biological effectiveness (RBE) of fast neutrons, assessed by clinical signs and by gross and microscopic pathology, is between 3 and 4.5 for pancreas, ~4.5 for heart, pylorus, duodenum, and kidney, and greater than 6.75 for liver. Ten malignancies and two benign tumors developed in the irradiated field of six of 12 neutron-exposed dogs that survived over one year after irradiation. Two malignancies and one benign tumor arose in three of 12 photon-exposed dogs surviving over one year postirradiation. Only one neoplasm developed in the same field in 11 nonirradiated controls or in 62 dogs irradiated at sites other than the thorax or abdomen. The neutron RBE for neoplasia is approximately 6.75. 85 refs., 8 figs., 3 tabs.

23038 (CONF-830951—, pp 219-236) **Lifetime effects of single-event proton exposures in rhesus monkeys.** Wood, D.H.; Yochmowitz, M.G.; Salmon, Y.L. (Air Force School of Aerospace Medicine, Brooks Air Force Base, TX (USA)). Oct 1986. NTIS, PC A99. Order Number TI87000490/JAW.

From 22. Hanford life sciences symposium - life-span radiation effects studies in animals - what can they tell us; Richland, WA, USA (27 Sep 1983).

The US School of Aerospace Medicine studies of the lifetime effects of proton irradiation in rhesus monkeys have been conducted. Life-span shortening has been associated with proton energies of 55 MeV and above, as well as with doses greater than 360 rads. Female rhesus monkeys have a higher mortality than males as a result of high incidence of endometriosis in the irradiated animals. A dose ordering effect is apparent. Mortality rates began to accelerate at eight years after doses of 360 to 400 rads; at two years, after 500 to 650 rads; and less than one year, after 800 rads. Malignant tumors accounted for 18% of the deaths in the proton-exposed animals. Endometriosis was the cause of 25% of the deaths in this group. Energy-specific effects were observed. Eight malignant brain tumors occurred in animals exposed to 55-MeV protons and in no other group. Cataract incidence was highest in animals exposed to 32 and 55 MeV. These observations suggest a positive relationship with the Bragg peak energy distribution in the area of the brain and crystalline lens. Glucose tolerance was lowest in the animals exposed to totally penetrating radiation, where the fraction of the surface dose reaching the pancreas was highest. Age-matched control animals have yet to pass their median survival time, and the colony continues to be a valuable source of data on the relationship of total-body radiation to age-related diseases in captive monkeys. 16 refs., 6 figs., 5 tabs.

23039 (CONF-830951—, pp 243-252) **Life expectancy for the University of Utah beagle colony and selection of a control group.** Atherton, D.R.; Stevens, W.; Bruenger, F.W.; Woodbury, L.; Stover, B.J.; Smith, J.M.; Wrenn, M.E. (Univ. of Utah, Salt Lake City (USA)). Oct 1986. NTIS, PC A99. Order Number TI87000490/JAW. Contract AC02-76EV00119.

From 22. Hanford life sciences symposium - life-span radiation effects studies in animals - what can they tell us; Richland, WA, USA (27 Sep 1983).

In the internal-emitters toxicity program at the University of Utah Radiobiology Laboratory, each experimental group carries its own specific control cohort, which is the same size as most of the individual experimental cohorts. Variations in average lifetime are observed among individual control cohorts. This may be due to external causes, genetic variances such as the occurrence of epileptic syndromes, or changes such as those that result from improved medical core or husbandry. The Stover-Eyring method was used to eliminate from control and experimental cohorts those dogs with specific diseases such as epilepsy - dogs that were at risk for too short a time for a later pathological response to occur. By the use of conventional statistical techniques, it ws shown to be reasonable to pool individual control cohorts into a much larger selected cohort that provided greater precision in the estimate of control survival and thus a more sensitive basis for the estimation of the relative life shortening in the experimental groups. The analysis suggested that control groups could be combined, and a control population of 114 beagles was proposed. Their average lifespan was 4926 +- 849 days, and the time when half the animals had died was 5000 days. 3 refs., 2 figs., 5 tabs.

23040 (CONF-830951—, pp 253-267) **Summary of dosimetry, pathology, and dose response for bone sarcomas in beagles injected with radium-226.** Wrenn, M.E.; Taylor, G.N.; Stevens, W.; Mays, C.W.; Jee, W.S.S.; Lloyd, R.D.; Atherton, D.R.; Bruenger, F.W.; Kimmel, D.B.; Miller, S.C. (Univ. of Utah, Salt Lake City (USA)). Oct 1986. NTIS, PC A99. Order Number TI87000490/JAW. Contract AC02-76EV00119.

From 22. Hanford life sciences symposium - life-span radiation effects studies in animals - what can they tell us; Richland, WA, USA (27 Sep 1983).

In the completed ^{226}Ra portion of a 30-year-long experiment to determine the relative radiotoxicity of injected ^{226}Ra and ^{239}Pu, 42 of 116 animals injected with ^{226}Ra developed 63 bone sarcomas; none were observed in 44 controls. Average alpha plus beta dose to the skeleton to death was calculated on the basis of mathematical functions developed from sequential measurements of radium and radon retention in each dog. Bone sarcomas were identified radiographically or clinically, with subsequent histopathological confirmation and classification. Most primary bone tumors were classified as osteosarcomas if osteoid arose from a malignant stroma. The dose-response curve over the six lowest injected dose levels fits well to a linear, no-threshold, least squares fit, through a control incidence of 0.8%, and with a slope of 0.042% incidence per rad. 19 refs., 5 figs., 2 tabs.

23041 (CONF-830951—, pp 268-285) **Incidence of liver tumors in beagles with body burdens of ^{239}Pu or ^{241}Am.** Taylor, G.N.; Mays, C.W.; Wrenn, M.E.; Shabestari, L.; Lloyd, R.D. (Univ. of Utah, Salt Lake City (USA)). Oct 1986. NTIS, PC A99. Order Number TI87000490/JAW. Contract AC02-76EV00119.

From 22. Hanford life sciences symposium - life-span radiation effects studies in animals - what can they tell us; Richland, WA, USA (27 Sep 1983).

Tetravalent ^{239}Pu or trivalent ^{241}Am in a citrate buffer, given via a single intravenous injection to beagles, induced very pronounced liver changes, usually at relatively long postinjection times. The lesions consisted of cell injury or cell necrosis which was followed by nodular hyperplasia and a significant incidence of primary liver tumors. The most frequent neoplasm was the bile duct adenoma, followed by the bile duct carcinoma. A lesser number of sarcomas were also induced, especially fibrosarcomas. The number of hepatic cell tumors was low. An abnormally high incidence of both hyperplastic nodules and primary liver tumors occurred at long postinjection times and at average doses extending down to ~10 rads. The various nodular lesions and liver tumors frequently occurred as incidental findings in dogs dying from other causes, especially bone cancer. In comparison to bone neoplasia, the liver was a much less important target organ in the high-dose level groups, but in some of the low-dose groups, especially in the ^{241}Am groups, the risk of radiation-induced liver cancer was approximately equal to or exceeded the risk of skeletal tumors. However, in any projection of the risks observed in this animal model to man, one should be mindful that the beagle skeleton is approximately 25 times more sensitive to radiation-induced bone neoplasia than is the human skeleton (Mays et al., 1976) and that the radiosensitivity difference for the beagle and human liver is unknown. 41 refs., 8 figs., 5 tabs.

23042 (CONF-830951—, pp 286-298) **Tissue characteristics of high- and low-incidence plutonium-induced osteogenic sarcoma sites in life-span beagles.** Miller, S.C.; Jee, W.S.S.; Smith, J.M.; Wronski, T.J. (Univ. of Utah, Salt Lake City (USA); Univ. of Florida, Gainesville (USA)). Oct 1986. NTIS, PC A99. Order Number TI87000490/JAW.

From 22. Hanford life sciences symposium - life-span radiation effects studies in animals - what can they tell us; Richland, WA, USA (27 Sep 1983).

On the basis of information gathered from the ^{239}Pu life-span study in beagles at the University of Utah, the tissue features were found to be characteristic of high-incidence bone-tumor sites compared to low-incidence sites included more hematopoietic tissues in the bone marrow; greater trabecular bone mass; greater bone remodeling rates; greater mineral apposition rates; greater density and activity of bone surface cells; greater density of putative bone-cell precursors; greater initial uptake of plutonium on bone surfaces; and greater marrow vascular volumes and a venous sinusoidal bed. Although most of these studies are not yet complete, the information being collected should contribute to our understanding of the mechanisms of radiation-induced osteogenic sarcomas. This should aid in predicting the types and characteristics of osseous tissues where radiation-induced osteogenic sarcomas may arise in humans. 25 refs., 4 figs., 3 tabs.

23043 (CONF-830951—, pp 299-310) **Toxicity ratios: Their use and abuse in predicting the risk from induced cancer.** Mays, C.W.; Taylor, G.N.; Lloyd, R.D. (Univ. of Utah, Salt Lake City (USA)). Oct 1986. NTIS, PC A99. Order Number TI87000490/JAW. Contract AC02-76EV00119.

From 22. Hanford life sciences symposium - life-span radiation effects studies in animals - what can they tell us; Richland, WA, USA (27 Sep 1983).

The toxicity ratio concept assumes the validity of certain relationships. In some examples for bone sarcoma induction, the approximate toxicity of ^{239}Pu in man can be calculated algebraically from the observed toxicity in the radium-dial painters and the ratio of $^{239}Pu/^{226}Ra$ toxicities in suitable laboratory mammals. In a species highly susceptible to bone sarcoma induction, the risk coefficients for both ^{239}Pu and ^{226}Ra are elevated, but the toxicity ratio of ^{239}Pu to ^{226}Ra tends to be similar to the ratio in resistant species. Among the tested species the toxicity ratio of ^{239}Pu to ^{226}Ra ranged from 6 to 22 (a fourfold range), whereas their relative sensitivities to ^{239}Pu varied by a factor of 150. The toxicity ratio approach can also be used to estimate the actinide risk to man from liver cancer, by comparing to the Thorotrast patients; from lung cancer, by comparing to the uranium miners and the atomic-bomb survivors; and from neutron-induced cancers, by comparing to cancers induced by gamma rays. The toxicity ratio can be used to predict the risk to man from a specific type of cancer that has been reliably induced by a reference radiation in humans and that can be induced by both the reference and the investigated radiation in suitable laboratory animals. 26 refs., 3 figs., 1 tab.

23044 (CONF-830951—, pp 311-319) **The Eyring-Stover theory of survival applied to life-span radiation effects studies in animals.** Stover, B.J.; Wrenn, M.E.; Jee, W.S.S.; Atherton, D.R. (Univ. of North Carolina at Chapel Hill School of Medicine (USA); Univ. of Utah School of Medicine, Salt Lake City (USA)). Oct 1986. NTIS, PC A99. Order Number TI87000490/JAW. Contract AC02-76EV00119.

From 22. Hanford life sciences symposium - life-span radiation effects studies in animals - what can they tell us; Richland, WA, USA (27 Sep 1983).

The Eyring-Stover theory of survival describes the observed biological phenomena of damage and repair as steady-state processes that can be expressed in the formalism of absolute reaction rate theory. The steady-state formulation, rather than that of dynamic equilibrium, is invoked since biological phenomena, in contrast with most chemical and physical phenemena, are time irreversible. The theory is appropriate for calculating life shortening that results from environmental factors such as irradiation since it does not require universality and intrinsicality as to some theories of aging. The theory gives not only midrange mortality rate values but also end-range values, which are difficult to predict empirically. The previously calculated life shortening of mice after external x-irradiation and of beagles after internal irradiation from ^{239}Pu or ^{226}Ra is reviewed; life shortening at low dose levels of ^{226}Ra is presented. 21 refs., 1 tab.

23045 (CONF-830951—, pp 320-342) **Use of three-dimensional lognormal dose-response surfaces in lifetime studies of radiation-induced cancer.** Raabe, O.G. (Univ. of California, Davis (USA)). Oct 1986. NTIS, PC A99. Order Number TI87000490/JAW. Contract AC03-76SF00472.

From 22. Hanford life sciences symposium - life-span radiation effects studies in animals - what can they tell us; Richland, WA, USA (27 Sep 1983).

The three-dimensional lognormal cumulative probability power function was used to provide a unifying dose-response description of the lifetime cancer risk for chronic exposure of experimental animals and people, for risk evaluation, and for scaling between species. Bone tumor fatilities, primarily from alpha irradiation of the skeleton in lifetime studies of beagles injected with ^{226}Ra, were shown to be well described by this function. This function described cancer risk in lifetime studies as a curved smooth surface depending on radiation exposure rate and elapsed time, such that the principal risk at low dose rates occurred near the end of the normal life span without significant life shortening. Essentially identical functions with the median value of the power function dis-

placed with respect to appropriate RBE values were shown to describe bone-cancer induction primarily from alpha irradiation of the skeleton in lifetime beagle studies with injected ^{226}Ra, ^{228}Th, ^{239}Pu and ^{241}Am, and with inhaled ^{238}Pu. Application of this model to human exposures to ^{226}Ra yielded a response ratio of 3.6; that is, the time required for development of bone cancer in people was 3.6 times longer than for beagles at the same average skeletal dose rate. It was suggested that similar techniques were appropriate to other carcinogens and other critical organs. 20 refs., 8 figs., 3 tabs.

23046 (CONF-830951—, pp 349-356) **Carcinogenesis in C57BL mice after multigeneration exposure of the male germinal line to tritium.** Mewissen, D.J.; Ugarte, A.S.; Rust, J.J. (Univ. of Chicago, IL (USA); Free Univ. of Brussels (Belgium)). Oct 1986. NTIS, PC A99. Order Number TI87000490/JAW.

From 22. Hanford life sciences symposium - life-span radiation effects studies in animals - what can they tell us; Richland, WA, USA (27 Sep 1983).

The occurrence of a heritable, multiple intestinal adenocarcinoma (HMIA) was observed in the offspring of an outcross between a male (or female) parent originating from our C57 Black/6M strain and his female (or male) mating counterpart originating from an experimental subline of the same strain, propagated with multigeneration exposure of the male parent to low-level tritium. Multiple intestinal malignancy was observed with a high-expression frequency in all animals examined in five subsequent generations, irrespective of the sex of the initial ascendant originating from the experimental subline, exposed to tritiated water. A digenic inheritance with partial penetrance is postulated, involving at least a two-stage process of tumorigenesis, namely, a dominant mutation at one locus and a second mutation to a recessive which, as long as it remained homozygous, prevented expression of the tumorigenic dominant gene. 10 refs., 2 tabs.

23047 (CONF-830951—, pp 357-367) **Life shortening and carcinogenesis in mice irradiated at the perinatal period with gamma rays.** Sasaki, S.; Kasuga, T. (National Institute of Radiological Sciences, Chiba (Japan); Tokyo Medical and Dental Univ. (Japan)). Oct 1986. NTIS, PC A99. Order Number TI87000490/JAW.

From 22. Hanford life sciences symposium - life-span radiation effects studies in animals - what can they tell us; Richland, WA, USA (27 Sep 1983).

This study elucidates the life-span radiation effects in mice irradiated at the perinatal period in comparison to mice irradiated at the young adult period. $B6C3F_1$ female mice were irradiated at 17 days of prenatal age, at 0 days of postnatal age, or as young adults at 15 weeks of age with 190, 380, or 570 rads of ^{137}Cs gamma rays. Mice irradiated at the late fetal period showed dose-dependent life shortening of somewhat lesser magnitude than that seen after neonatal or young adult irradiation. Mice exposed at the late fetal period were highly susceptible to induction of pituitary tumors for which the latent period was the longest of all induced neoplasms. Incidence of lung tumors in mice irradiated at the late fetal period with 190 and 380 rads was higher than in controls. Malignant lymphomas of the lymphocytic type developed in excess, after a short latent period, in mice irradiated fetally with the highest dose; susceptibility of prenatally exposed mice was lower than that of early postnatally exposed mice. Liver tumors developed more frequently in mice irradiated in utero than in controls; susceptibility to induction of this type of neoplasm was highest at the neonatal period. In general, carcinogenic response of mice exposed at the late fetal period resembled that of neonatally exposed mice but was quite different from that of young adult mice. Mice exposed as young adults have no, or low, susceptibility to induction of pituitary, lung, and liver tumors; and a higher susceptibility to induction of myeloid leukemias and Harderian gland tumors. 19 refs., 4 figs., 3 tabs.

23048 (CONF-830951—, pp 368-380) **Life-span studies in ^{226}Ra-injected animals: Effect of low doses, effect of a decorporative treatment.** Schoeters, G.E.R.; Vanderborght, O.L.J. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)). Oct 1986. NTIS, PC A99. Order Number TI87000490/JAW.

From 22. Hanford life sciences symposium - life-span radiation effects studies in animals - what can they tell us; Richland, WA, USA (27 Sep 1983).

A life-span radiation effects study was performed in mice injected with several doses of ^{226}Ra. The study included 788 male C57Bl mice. For the removal of the ^{226}Ra, half the mice were treated daily with a diet 5% of which was sodium-alginate. The experiment revealed that mice that received the lowest dose of ^{226}Ra lived significantly longer than controls, and, despite appreciable skeletal removal of ^{226}Ra as a result of decorporative treatment, no biological benefit was observed in treated animals. 19 refs., 4 figs., 3 tabs.

23049 (CONF-830951—, pp 381-394) **Diminished lifetime reproductive capacity in the female after early radiation exposure.** Dobson, R.L.; Kwan, T.C.; Brunckhorst, B.F.; Straume, T. (Lawrence Livermore National Lab., CA (USA)). Oct 1986. NTIS, PC A99. Order Number TI87000490/JAW. Contract W-7405-ENG-48.

From 22. Hanford life sciences symposium - life-span radiation effects studies in animals - what can they tell us; Richland, WA, USA (27 Sep 1983).

To measure effects of early tritium-induced oocyte loss on lifetime reproduction, we determined total reproductive capacity (RC) of female mice in which known oocyte deficiencies had been produced in early life by chronic exposure to ^3HOH administered to their mothers in drinking water from the day of conception to 14 days postpartum. At that time ^3HOH administration was stopped, and oocytes were enumerated in the suckling young. Over the subsequent two years, RC was determined in these young by counting the litters and offspring they produced during continuous breeding over their entire reproductive life spans. Offspring were removed at birth to avoid interrupting the breeding process. Tritium-induced diminution of RC was found to be done dependent but less than - and, interestingly, different from - diminution of oocyte number. Oocyte loss was stochastic; RC reduction, nonstochastic. Also, despite oocyte deficiencies, productivity of exposed females tended to be normal during early reproductive life but failed prematurely as oocytes ran out. 15 refs., 4 figs., 3 tabs.

23050 (CONF-830951—, pp 395-403) **Relative effect of radiation dose rate on hemopoietic and nonhemopoietic lethality of total-body irradiation.** Peters, L.J.; McNeill, J.; Karolis, C.; Thames, H.D. Jr.; Travis, E.L. (M.D. Anderson Hospital and Tumor Institute at Houston, TX (USA); Australian Atomic Energy Commission, Lucas Heights; Prince of Wales Hospital, Randwick (Australia)). Oct 1986. NTIS, PC A99. Order Number TI87000490/JAW.

From 22. Hanford life sciences symposium - life-span radiation effects studies in animals - what can they tell us; Richland, WA, USA (27 Sep 1983).

Experiments were undertaken to determine the influence of dose rate on the toxicity of total-body irrdiation (TBI) with and without syngeneic bone-marrow rescue in mice. The results showed a much greater dose-rate dependence for death from nonhemopoietic toxicity than from bone-marrow ablation, with the ratio of LD_{50}'s increasing from 1.73 at 25 cGy/min to 2.80 at 1 cGy/min. At the higher dose rates, dose-limiting nonhemopoietic toxicity resulted from late organ injury, affecting the lungs, kidneys, and liver. At 1 cGy/min the major dose-limiting nonhemopoietic toxicity was acute gastrointestinal injury. The implications of these results in the context of TBI in preparation for bone-marrow transplantation are discussed. 15 refs., 4 figs.

23051 (CONF-830951—, pp 404-412) **The comparative carcinogenicity of ^{239}Pu, ^{241}Am, and ^{244}Cm in the rat.** Taylor, D.M. (Kernforschungszentrum Karlsruhe (Germany, F.R.); Univ. of Heidelberg (Germany, F.R.)). Oct 1986. NTIS, PC A99. Order Number TI87000490/JAW.

From 22. Hanford life sciences symposium - life-span radiation effects studies in animals - what can they tell us; Richland, WA, USA (27 Sep 1983).

Five completed studies compared the effects of ^{239}Pu, ^{241}Am, and ^{244}Cm in August-Marshall F_1 hybrid rats. Osteosarcomas were observed in all the treated groups but not in any control group. More than 70% of the osteosarcomas occurred in the

lumber or thoracic vertebrae, the femur, or the tibia with all three radionuclides, but there is an indication that a smaller proportion of the tumors arises in the vertebrae after ^{239}Pu administration than after either of the other two radionuclides. Risk coefficients are ^{239}Pu, 487 +- 52; ^{241}Am, 175 +- 32; ^{244}Cm, 162 +- 45. These risk coefficients suggest that in the rat ^{239}Pu is about three times more effective for bone tumor induction than the other two radionuclides. A small number of leukemias, mainly of myelogenous origin, and a small number of other soft-tissue tumors were observed in the radionuclide-injected groups. No leukemias were observed in many hundreds of control animals. 14 refs., 4 tabs.

23052 (CONF-830951—, pp 413-428) **Combined effects of inhaled plutonium oxide and benzo[a]pyrene on lung carcinogenesis in rats.** Metivier, H.; Masse, R.; Wahrendorf, J.; Lafuma, J. (Commissariat a l'Energie Atomique, Centre de Bruyeres le Chatel (France); International Agency for Research on Cancer, Lyon (France)). Oct 1986. NTIS, PC A99. Order Number TI87000490/JAW.

From 22. Hanford life sciences symposium - life-span radiation effects studies in animals - what can they tell us; Richland, WA, USA (27 Sep 1983).

This study describes the effect of two intratracheal instillations (5 mg each) of benzo[a]pyrene (BP) on lung carcinogenesis in rats that had previously inhaled three levels of $^{239}PuO_2$. The BP does not modify survival in the high-level $^{239}PuO_2$-exposed rats, but markedly reduces survival in the two other groups. Median survival time with BP alone is shorter (666 days) than for the control group (838 days). Tumor incidence was increased by BP exposure, and the tumors were usually fatal, whereas tumors observed after $^{239}PuO_2$ inhalation alone were usually not fatal. Statistical analysis of these data poses a problem because of the need to compare incidental and fatal tumors. 22 refs., 5 figs., 7 tabs.

23053 (CONF-830951—, pp 429-449) **Low-level inhaled-$^{239}PuO_2$ life-span studies in rats.** Sanders, C.L.; McDonald, K.E.; Killand, B.W.; Mahaffey, J.A.; Cannon, W.C. Oct 1986. NTIS, PC A99. Order Number TI87000490/JAW.

From 22. Hanford life sciences symposium - life-span radiation effects studies in animals - what can they tell us; Richland, WA, USA (27 Sep 1983).

This study determined the dose-response curve for lung tumor incidence in rats after inhalation of high-fired $^{239}PuO_2$, which gave radiation doses to the lung of from ~5 to >1000 rads. Exposed rats were given a single, nose-only, inhalation exposure to ^{169}Yb-$^{239}PuO_2$ aerosol (AMAD, 1.6 +- 0.11 μm). The effective half-time for ^{169}Yb in the lung was 14 days, whereas ~76% of ^{239}Pu was cleared with a half-time of 20 days and 24%, with a half-time of 180 days. Whole-body counting for ^{169}Yb at 14 days after exposure was an accurate method for determining ^{239}Pu IAD in individual rats, even at IAD's as low as 0.60 nCi of ^{239}Pu. The ^{239}Pu lung-clearance curve and an equation describing changes in lung weight with body weight and age were used to determine lung radiation doses. The IAD's of exposure groups were 0.60 +- 0.15 nCi of ^{239}Pu (1000 rats), 0.98 +- 0.25 (531 rats), 2.4 +- 0.69 (209 rats), 5.7 +- 1.2 (98 rats), and 7.5 +- 2.0 to 150 +- 37 nCi (300 rats); corresponding radiation doses to the lung estimated at 3 years after exposure were 8.3, 14, 33, 79, and 100 to 2100 rads, respectively. 71 refs., 5 figs., 4 tabs.

23054 (CONF-830951—, pp 455-470) **Current status of life-span studies with inhaled plutonium in beagles at Pacific Northwest Laboratory.** Park, J.F.; Dagle, G.E.; Ragan, H.A.; Weller, R.E.; Stevens, D.L. Oct 1986. NTIS, PC A99. Order Number TI87000490/JAW. Contract AC06-76RL01830.

From 22. Hanford life sciences symposium - life-span radiation effects studies in animals - what can they tell us; Richland, WA, USA (27 Sep 1983).

Beagles that inhaled $^{239}PuO_2$, $^{238}PuO_2$, or $^{239}Pu(NO_3)_4$, in dose-level groups of 20 dogs, with initial lung burdens of ~2, 15, 70, 300, 1100, or 5500 nCi, are now 11, 9, or 5 years postexposure. Lung tumors, bone tumors, and radiation pneumonitis, the plutonium-exposure-related causes of death observed to date, have occurred in the two, three, and four highest dose-level groups exposed to $^{238}PuO_2$, $^{239}Pu(NO_3)_4$, and $^{239}PuO_2$, respectively. No plutonium-exposure-related deaths have thus far been observed in dose-level groups exposed to less than ~40 times the current maximum permissible lung dose for a plutonium worker. Plutonium-exposure-related effects not directly related to the cause of death include chronic lymphopenia, chronic neutropenia, sclerosis of the tracheobronchial lymph nodes, focal radiation pneumonitis, adenomatous hyperplasia in the liver, and dystrophic osteolytic lesions in the skeleton. No plutonium-exposure-related effects have thus far been observed in dose-level groups that received less than ~15 times the current maximum permissible lung dose for a plutonium worker. 10 refs., 5 figs., 4 tabs.

23055 (CONF-830951—, pp 471-476) **Pathology associated with inhaled plutonium in beagles.** Dagle, G.E.; Park, J.F.; Weller, R.E.; Ragan, H.A.; Stevens, D.L. Oct 1986. NTIS, PC A99. Order Number TI87000490/JAW. Contract AC06-76RL01830.

From 22. Hanford life sciences symposium - life-span radiation effects studies in animals - what can they tell us; Richland, WA, USA (27 Sep 1983).

The pathology associated with the inhalation of plutonium was studied in beagle dogs given a single exposure to aerosols of $^{239}PuO_2$, $^{238}PuO_2$, or $^{239}Pu(NO_3)_4$. The temporal-spatial relationships between plutonium deposition and the development of lesions in dogs were evaluated up to 11 years, 8 years, or 5 years, respectively, after exposures, resulting in initial lung burdens ranging from ~2 to ~5500 nCi. Exposure of the lung to high dose levels produced a spectrum of progressively more severe morphological changes, ranging from radiation pneumonitis to fibrosis. Lung tumors occurred at exposure levels that did not result in early death from radiation pneumonitis or fibrosis. Bronchiolar-alveolar carcinomas, papillary adenocarcinomas, epidermoid carcinomas, and combined epidermoid and adenocarcinomas were observed. Sclerosing tracheobronchial lymphadenitis, radiation osteodystrophy, osteosarcoma, and hepatic adenomatous hyperplasia were the principal extrapulmonary lesions resulting from translocation of plutonium. 15 refs., 2 tabs.

23056 (CONF-830951—, pp 477-487) **Hematologic effects of inhaled plutonium in beagles.** Ragan, H.A.; Buschbom, R.L.; Park, J.F.; Dagle, G.E.; Weller, R.E. Oct 1986. NTIS, PC A99. Order Number TI87000490/JAW.

From 22. Hanford life sciences symposium - life-span radiation effects studies in animals - what can they tell us; Richland, WA, USA (27 Sep 1983).

Beagle dogs were exposed, by inhalation, 5 to 11 years ago, to aerosols of $^{239}PuO_2$, $^{238}PuO_2$, or $^{239}Pu(NO_3)_4$, at six dose levels resulting in initial lung burdens ranging from ~2 to ~5500 nCi. Translocation of the plutonium to extrapulmonary sites was related to the physical-chemical characteristics of the plutonium compound. The highly insoluble $^{239}PuO_2$ was retained primarily in the lung and associated lymph nodes, whereas $^{239}Pu(NO_3)_4$ was much more soluble and translocated relatively rapidly to the skeleton and other extrapulmonary tissues. The $^{238}PuO_2$ was intermediate in solubility and translocation characteristics. The hematologic effects of plutonium inhalation were most pronounced on lymphocyte populations. Evidence suggests that these effects result from irradiation of lymphocytes via the pulmonary lymph nodes with insoluble $^{239}PuO_2$, and via these same lymph nodes, extrapulmonary lymph nodes, and bone marrow lymphocytes with the more soluble forms, i.e., $^{238}PuO_2$ and $^{239}Pu(NO_3)_4$. There is no evidence suggesting that these exposures increase the risk of developing myeloid or lymphoid neoplasia. 8 refs., 4 figs., 3 tabs.

23057 (CONF-830951—, pp 488-495) **Application of a systematized nomenclature of veterinary medicine (SNOVET) to diagnostic coding and retrieval of clinical life-span data in beagle dogs exposed to plutonium.** Weller, R.E.; Park, J.F.; Stevens, D.L.; Park, C.L. Oct 1986. NTIS, PC A99. Order Number TI87000490/JAW. Contract AC06-76RL01830.

From 22. Hanford life sciences symposium - life-span radiation effects studies in animals - what can they tell us; Richland, WA, USA (27 Sep 1983).

A data-management system, utilizing the Systematized Nomenclature of Veterinary Medicine (SNOVET), was implemented to collect data generated by our life-span canine studies. Information is encoded and retrieved by specific categories. These data are

analyzed statistically to look for significant effects related to exposure to radionuclides. Preliminary use for evaluation of the SNOVET system revealed statistically significant differences in survival between control and exposed animals. Also, there appears to be an increased risk of testicular and reproductive tract disorders with increasing dose. 8 refs., 3 figs., 2 tabs.

23058 (CONF-830951—, pp 501-520) **An interspecies comparison of the biological effects of an inhaled, relatively insoluble beta emitter.** Griffith, W.C.; Lundgren, D.L.; Hahn, F.F.; Boecker, B.B.; McClellan, R.O. (Lovelace Biomedical and Environmental Research Institute, Albuquerque, NM (USA)). Oct 1986. NTIS, PC A99. Order Number TI87000490/JAW. Contract AC04-76EV01013.

From 22. Hanford life sciences symposium - life-span radiation effects studies in animals - what can they tell us; Richland, WA, USA (27 Sep 1983).

Mice, rats, Syrian hamsters, and beagle dogs were exposed by inhalation to graded levels of ^{144}Ce in relatively insoluble forms to demonstrate species similarities and differences regarding patterns of deposition, fate, dosimetry, and dose-response relationships. All animals were serially evaluated to determine lung burdens, held for life-span observation, necropsied at death, and examined histopathologically to characterize the lesions present and to determine the cause of death. The primary malignant lung tumors observed in rodents were predominantly squamous-cell carcinomas and adenocarcinomas, whereas those in dogs at earlier times were primarily hemangiosarcomas and those in dogs that died at later times were pulmonary carcinomas. The relationship between the incidence of lung cancer and absorbed beta dose to the lung differed among species. The results of modeling these data provide a better understanding of how the choice of species can influence the outcome of a life-span study. The data are used to estimate the risk of lung cancer in man from an inhaled beta-emitting radionuclide. 26 refs., 5 figs., 6 tabs.

23059 (CONF-830951—, pp 521-534) **Insights into radionuclide-induced lung cancer in people from life-span studies in beagle dogs.** Hahn, F.F.; Muggenburg, B.A.; Boecker, B.B.; Cuddihy, R.G.; Griffith, W.C.; Guilmette, R.A.; McClellan, R.O.; Mewhinney, J.A. (Lovelace Biomedical and Environmental Research Institute, Albuquerque, NM (USA)). Oct 1986. NTIS, PC A99. Order Number TI87000490/JAW. Contract AC04-76EV01013.

From 22. Hanford life sciences symposium - life-span radiation effects studies in animals - what can they tell us; Richland, WA, USA (27 Sep 1983).

In life-span studies, beagle dogs were exposed one time by inhalation to an aerosol containing a beta- or alpha-emitting radionuclide in a relatively soluble or insoluble chemical form. After exposure dogs were observed for late-occurring biological effects. Lung cancer has been a predominant observation for radionuclides inhaled in a relatively insoluble form because most of the absorbed dose was delivered to the lung and contiguous tissues. Approximately 130 lung cancers were observed in dogs exposed to inhaled beta-emitting radionuclides; tumors occurred with absorbed doses to lung ranging from 1100 to 68,000 rads. With inhaled alpha emitters lung tumors occurred at doses between 530 and 8400 rads. Dose rate pattern was shown to be an important factor in the induction of lung cancer by inhaled beta emitters. Doses of low-LET irradiation delivered in a matter of days can be as much as 8 times more effective per unit of dose than radiation doses delivered over a more protracted period of time. Tumors also have occurred in tracheobronchial lymph nodes of dogs that inhaled relatively insoluble forms of beta emitters. From these studies, the risk of lung cancer from inhaled beta- or alpha-emitting radionuclides was compared to determine the importance of LET and other dose-effect modifying factors on resulting risks and on extrapolation to human inhalation exposure. Attention also was given to the risk of cancer in tracheobronchial lymph nodes, on the basis of the results of these studies and the current ICRP computational method in which lymph nodes are included with lung for purposes of dose and risk calculation. 12 refs., 3 figs., 4 tabs.

23060 (CONF-830951—, pp 535-555) **Incidence of bone cancer in beagles after inhalation of $^{90}SrCl_2$ or $^{238}PuO_2$: Implications for estimation of risk to humans.** Mewhinney, J.A.; Griffith, W.C.; Hahn, F.F.; Snipes, M.B.; Boecker, B.B.; McClellan, R.O. (Lovelace Biomedical and Environmental Research Institute, Albuquerque, NM (USA)). Oct 1986. NTIS, PC A99. Order Number TI87000490/JAW. Contract AC04-76EV01013.

From 22. Hanford life sciences symposium - life-span radiation effects studies in animals - what can they tell us; Richland, WA, USA (27 Sep 1983).

Among the life-span studies conducted with beagle dogs, bone cancer has been in two studies the predominant effect at death. These studies involved dogs that inhaled $^{90}SrCl_2$, which is very soluble in body fluids; and dogs that inhaled $^{238}PuO_2$, which is initially insoluble but eventually becomes fragmented and more soluble. Both radionuclides were deposited in the skeleton after dissolution in the lung and absorption into the bloodstream. All dogs in the ^{90}Sr study are dead, and all living dogs in the ^{239}Pu study are at least 7 years postexposure. Results from these two studies were compared to determine the relative biological effectiveness (RBE) of chronic beta and alpha radiation delivered from these two radionuclides. These data also were used to estimate the risk of bone cancer in man by using comparisons with data from the ^{90}Sr-, ^{239}Pu-, and ^{226}Ra-injected dogs at the University of Utah and data on humans who ingested ^{226}Ra or were injected with ^{224}Ra. Such comparisons provided a link between studies in laboratory animals and the available human data. In this way risks of bone cancer in humans from inhaled plutonium or strontium were estimated, even though currently no human cases of bone cancer are known to have resulted from the inhalation of either of these radionuclides. 15 refs., 7 figs., 7 tabs.

23061 (CONF-830951—, pp 556-563) **The risk of liver tumors in dogs and man from radioactive aerosols.** Muggenburg, B.A.; Boecker, B.B.; Hahn, F.F.; Griffith, W.G.; McClellan, R.O. (Lovelace Biomedical and Environmental Research Institute, Albuquerque, NM (USA)). Oct 1986. NTIS, PC A99. Order Number TI87000490/JAW. Contract AC04-76EV01013.

From 22. Hanford life sciences symposium - life-span radiation effects studies in animals - what can they tell us; Richland, WA, USA (27 Sep 1983).

Life-span studies in progress using beagle dogs that inhaled relatively soluble or relatively insoluble forms of radionuclides will provide information from which we may project the risk to humans for liver cancer from inhaled radioactive material. Twenty-two liver tumors have been observed in dogs exposed to beta-emitting radionuclides, mainly ^{144}Ce, and one liver tumor in a dog exposed to ^{238}Pu. Two liver cancers were also observed in control dogs. The risk of liver cancer in dogs that inhaled beta-emitting radionuclides was calculated to be 90 liver cancers per million rads. The risk of liver cancers in dogs in our studies and in studies at the University of Utah, when compared to the incidence of liver tumors in humans exposed to Thorotrast, suggest that the risk of liver cancer from an inhaled beta-emitting radionuclide in people is about 30 liver cancers per million person-rads. 19 refs., 3 tabs.

23062 (CONF-830951—, pp 564-577) **Is the human nasal cavity at risk from inhaled radionuclides?.** Boecker, B.B.; Hahn, F.F.; Cuddihy, R.G.; Snipes, M.B.; McClellan, R.O. (Lovelace Biomedical and Environmental Research Institute, Albuquerque, NM (USA)). Oct 1986. NTIS, PC A99. Order Number TI87000490/JAW. Contract AC04-76EV01013.

From 22. Hanford life sciences symposium - life-span radiation effects studies in animals - what can they tell us; Richland, WA, USA (27 Sep 1983).

In a series of three life-span studies in which beagle dogs inhaled relatively soluble forms of beta-emitting radionuclides, a number of cancers of the nasal cavity have arisen at long times after the inhalation exposure. No such cancers were observed in the control dogs. Data obtained in other studies involving serial sacrifice of dogs that received these radionuclides in similar forms have shown that high local concentrations of the radionuclides can persist in nasal turbinates for long periods of time, depending on the

physical half-life of the radionuclide inhaled. Several nasal carcinomas have also been observed in dogs injected with $^{137}CsCl$ in which the relative concentrations of beta activity in the turbinate region were not as pronounced as in the above studies. Similar risks of sinonasal cancer were calculated for dogs in each of these studies regardless of differences in radionuclide, dosimetry, and route of administration. Since sinonasal cancers have occurred in people exposed to alpha-emitting radionuclides, it is reasonable to assume this could occur with beta emitters as well. Radiation protection guidelines should account for the sinonasal region being at risk. 23 refs., 1 fig., 6 tabs.

23063 (CONF-830951—, pp 578-591) **Use of studies with laboratory animals to assess the potential early health effects of combined internal alpha and beta irradiation.** Scott, B.R.; Hahn, F.F.; Guilmette, R.A.; Muggenburg, B.A.; Snipes, M.B.; Boecker, B.B.; McClellan, R.O. (Lovelace Biomedical and Environmental Research Institute, Albuquerque, NM (USA)). Oct 1986. NTIS, PC A99. Order Number TI87000490/JAW. Contract AC04-76EV01013.

From 22. Hanford life sciences symposium - life-span radiation effects studies in animals - what can they tell us; Richland, WA, USA (27 Sep 1983).

The potential health impacts of radionuclides released in nuclear accidents are of major concern to the public and to regulatory and other governmental agencies. One mode of potential exposure is by inhalation of airborne radionuclides, which could lead to combined internal irradiation by high (alpha) and low (beta) linear energy transfer (LET) radiations. Epidemiological data for health effects of human inhalation exposure are too limited to derive reliable estimates of risks of potential health effects. However, results of studies in which beagle dogs were exposed by inhalation to insoluble radioactive aerosols can be used to estimate expected effects in humans. Data for mortality from radiation pneumonitis and pulmonary fibrosis caused by internal irradiation of dog lungs by alpha or beta radiations are used to derive the relative biological effectiveness (RBE) of alpha irradiation compared to beta irradiation; predict the expected combined effects of alpha and beta irradiation of dog lungs; and extrapolate the results to humans. The extrapolation to humans assumed that, for similar ages at exposure, dog and human lungs have similar sensitivities to lung irradiation. Results of theoretical calculations related to mortality from early effects indicated that the synergistic effects of high- and low-LET radiations should depend on the percentages of the total dose contributed by high- and low-LET radiations, and for very low or very high doses, synergistic effects should be negligible. 23 refs., 8 figs.

23064 (CONF-830951—, pp 592-607) **Lung tumors and radon inhalation in over 2000 rats: Approximate linearity across a wide range of doses and potentiation by tobacco smoke.** Gray, R.G.; Lafuma, J.; Parish, S.E.; Peto, R. (Radcliffe Infirmary, Oxford (England); CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses (France)). Oct 1986. NTIS, PC A99. Order Number TI87000490/JAW.

From 22. Hanford life sciences symposium - life-span radiation effects studies in animals - what can they tell us; Richland, WA, USA (27 Sep 1983).

More than 2000 rats were exposed to cumulative doses of up to 28,000 WLMs of radon gas. More than 300 pulmonary tumors were induced by this exposure, most being nonfatal lesions detected only at autopsy of animals that had died of unrelated causes. Above 6000 WLMs rats suffered increasingly from life shortening due to radiation-induced nonneoplastic causes and so had less time in which to develop tumors. When adjusted for these competing causes of death, the hazard function for the excess risk of developing pulmonary tumors was approximately linearly related to dose throughout the range of doses studied. This suggests that some previously reported high-dose "reductions" in radiogenic tumor-induction rates may chiefly have involved the killing of rats rather than the killing of precursor cells. Rats exposed to radon and then to six months of inhalation of tobacco smoke had a four times greater age-specific prevalence of pulmonary tumors than rats exposed to an identical radon dose either alone or preceded by tobacco smoke inhalation. This suggests that tobacco smoke may accelerate the carcinogenic process by acting as a promoter of radiation-induced somatic damage. These data suggest that, for assessing human risk from exposure to radon, the linear model should be assumed, but that the WLM is not on its own an adequate index of carcinogenic insult. 7 refs., 2 figs., 4 tabs.

23065 (CONF-830951—, pp 608-623) **An overview of PNL radon experiments with reference to epidemiological data.** Cross, F.T.; Palmer, R.F.; Busch, R.H.; Dagle, G.E.; Filipy, R.E.; Ragan, H.A. Oct 1986. NTIS, PC A99. Order Number TI87000490/JAW. Contract AC06-76RL01830.

From 22. Hanford life sciences symposium - life-span radiation effects studies in animals - what can they tell us; Richland, WA, USA (27 Sep 1983).

Biological effects observed in dogs and rodents after the inhalation of radon and radon daughters have included, primarily, respiratory carcinoma, pulmonary fibrosis, emphysema, and lifespan shortening. Extrapulmonary lesions observed are not considered significant except for certain hematological effects. In this paper we present biological effects data resulting from chronic exposures of hamsters, rats, and beagle dogs. Emphasis is placed on the carcinogenic effects of radon and radon daughters, including the influences of radon-daughter exposure rate, unattachment fraction, and disequilibrium and of concomitant exposure to other pollutants. These data are correlated with results from human epidemiological studies. Plausible values for the radon (radon-daughter) lifetime lung-cancer risk coefficient are provided. 30 refs., 3 tabs.

23066 (CONF-830951—, pp 628-645) **Effects of x-irradiation of young female beagles on life span and tumor incidence.** Rosenblatt, L.S.; Book, S.A.; Goldman, M. (Univ. of California-Davis (USA)). Oct 1986. NTIS, PC A99. Order Number TI87000490/JAW. Contract AC03-76SF00472.

From 22. Hanford life sciences symposium - life-span radiation effects studies in animals - what can they tell us; Richland, WA, USA (27 Sep 1983).

Causes of death and the occurrence of neoplasia in female beagle dogs were evaluated retrospectively for 57 unexposed and 296 exposed dogs given single or fractionated whole-body x-irradiation exposures of 100 or 300 R. Some dogs subsequently were bred, and all were observed for the duration of their lives. The pathology for these dogs was derived from clinical records, gross-necropsy reports, tissue slides, and Formalin-fixed tissues. The results of this study indicated dose-related shortening of life span was clearly evident; causes of death due to either neoplasia (50%) or nonneoplastic disease (50%), with few exceptions, were similar in control and irradiated dogs; the incidences of neoplasms were not significantly greater for irradiated dogs than for controls, but the latency period decreased as dose increased; protraction increased survival in dogs given 300 R but not 100 R, which is attributable solely to amelioration of incidence rates of nonmammary neoplasia; and the cumulative rates of death due to mammary tumors were the same in dogs exposed to 100 R and 300 R. 14 refs., 6 figs., 2 tabs.

23067 (CONF-830951—, pp 646-659) **Lifetime effects of long-term exposures to strontium-90 and radium-226 in beagle dogs.** Book, S.A.; Rosenblatt, L.S.; Goldman, M. (Univ. of California at Davis (USA)). Oct 1986. NTIS, PC A99. Order Number TI87000490/JAW. Contract AC03-76SF00472.

From 22. Hanford life sciences symposium - life-span radiation effects studies in animals - what can they tell us; Richland, WA, USA (27 Sep 1983).

Graded doses of injected ^{226}Ra or ingested ^{90}Sr were given to 804 beagles in early life. The median survival times of the various irradiated groups at higher exposures were lower than the control value of 14.7 years. The ^{226}Ra group with the highest total skeletal dose had a median survival of 4.5 years. For ^{90}Sr the highest group had a median survival of 2.2 years. Normal life spans were evident in treatment groups with average skeletal doses of <290 rads to the skeleton from ^{226}Ra or of 2600 rads from ^{90}Sr. The life-shortening effects of ^{226}Ra and ^{90}Sr are related to the tumors produced from the radionuclide exposure. The significant causes of death among the ^{226}Ra-treated beagles were primary bone cancers, mostly osteosarcomas. Among dogs exposed to ^{90}Sr, significant numbers of deaths were from primary bone cancer, myeloproliferative disease, and squamous-cell carcinoma of the gingiva. In general, more of these effects were produced in the groups receiving higher doses and dose rates; at lower doses the effects,

when present, appeared later than they did at higher doses. 9 refs., 6 figs., 4 tabs.

23068 (CONF-830951—, pp 660-674) **Nonparametric statistical techniques used in dose estimation for beagles exposed to inhaled plutonium nitrate.** Stevens, D.L.; Dagle, G.E. Oct 1986. NTIS, PC A99. Order Number TI87000490/JAW. Contract AC06-76RL01830.

From 22. Hanford life sciences symposium - life-span radiation effects studies in animals - what can they tell us; Richland, WA, USA (27 Sep 1983).

Retention and translocation of inhaled radionuclides are often estimated from the sacrifice of multiple animals at different time points. The data for each time point can be averaged and a smooth curve fitted to the mean values, or a smooth curve may be fitted to the entire data set. However, an analysis based on means may not be the most appropriate if there is substantial variation in the initial amount of the radionuclide inhaled or if the data are subject to outliers. A method has been developed that takes account of these problems. The body burden is viewed as a compartmental system, with the compartments identified with body organs. A median polish is applied to the multiple logistic transform of the compartmental fractions (compartment burden/total burden) at each time point. A smooth function is fitted to the results of the median polish. This technique was applied to data from beagles exposed to an aerosol of $^{239}Pu(NO_3)_4$. Models of retention and translocation for lungs, skeleton, liver, kidneys, and tracheobronchial lymph nodes were developed and used to estimate dose. 4 refs., 3 figs., 4 tabs.

23069 (CONF-830951—, pp 675-682) **Estimation of initial lung deposition of inhaled $^{238}PuO_2$ in beagles.** Stevens, D.L.; Park, J.F. Oct 1986. NTIS, PC A99. Order Number TI87000490/JAW. Contract AC06-76RL01830.

From 22. Hanford life sciences symposium - life-span radiation effects studies in animals - what can they tell us; Richland, WA, USA (27 Sep 1983).

Studies to determine the life-span dose-effect relationship of inhaled $^{238}PuO_2$ in dogs require an estimate of initial lung deposition (ILD) to calculate the radiation dose to several organs. Ideally, this estimate of ILD is obtained by a summation of plutonium body burden at death plus all the plutonium excreted during the life of the dog. However, the high costs of excreta collection and of plutonium analyses for all excreta from each dog made it necessary to approximate the ILD by other less expensive methods. These methods could introduce error into the estimate of ILD and, consequently, into the radiation dose calculation. The objective of this work was to evaluate the potential error for several methods of estimating ILD. Thirteen beagle dogs were given a single 5- to 30-min exposure to $^{238}PuO_2$ aerosols, resulting in estimated ILD of 0.85 to 11.7 μCi of plutonium-238. Plutonium analyses of the tissues at death and of all excreta from these dogs were used for this evaluation. The estimate of ILD, obtained by summation of the plutonium body burden at death plus all the plutonium excreted, was compared to the estimated ILD obtained by the plutonium whole-body retention function for each dog, using all excreta data; the mean plutonium whole-body retention function for each dog, using all excreta data; the plutonium whole-body retention function for each dog, using partial excreta data; and a mean plutonium whole-body retention function for all dogs, using partial excreta data. 4 refs., 3 figs., 4 tabs.

23070 (CONF-830951—, pp 683-696) **Preliminary evaluation of lung doses for dogs exposed to $^{239}PuO_2$.** Fisher, D.R.; Cannon, W.C.; Hadley, R.T.; Park, J.F. Oct 1986. NTIS, PC A99. Order Number TI87000490/JAW. Contract AC06-76RL01830.

From 22. Hanford life sciences symposium - life-span radiation effects studies in animals - what can they tell us; Richland, WA, USA (27 Sep 1983).

A group of beagle dogs exposed to inhaled $^{239}PuO_2$ is being followed for life-span effects. This paper reports preliminary lung dose estimates and dose-response relationships for incidence of lung tumors and radiation pneumonitis which have been observed to date. Doses were estimated by using both conventional dose-averaging and microdosimetric techniques. Cascade impactor sampling data were used to reconstruct the original plutonium aerosol size distributions unique to each of about 120 individual dogs exposed to $^{239}PuO_2$. Data providing the initial plutonium lung burden and lifetime lung retention-clearance functions of plutonium for each dog were used for calculating average dose rates, cumulative absorbed doses, and specific energy distributions. A linear dose-response relationship for lung tumor induction was estimated on the basis of cumulative lung dose. Average time to death was estimated as a function of average dose rate. Conclusions regarding the potential value of microdosimetry in the interpretation of such dose-response relationships are discussed. 8 refs., 5 figs., 1 tab.

23071 (CONF-830951—, pp 697-709) **Tests for homogeneity for multiple 2 x 2 contingency tables.** Carr, D.B. Oct 1986. NTIS, PC A99. Order Number TI87000490/JAW. Contract AC06-76RL01830.

From 22. Hanford life sciences symposium - life-span radiation effects studies in animals - what can they tell us; Richland, WA, USA (27 Sep 1983).

Frequently data are described by 2 x 2 contingency tables. For example, each 2 x 2 table arises from two dichotomous classifications such as control/treated and respond/did not respond. Multiple 2 x 2 tables result from stratifying the observational units on the basis of other characteristics. For example, stratifying by sex produces separate 2 x 2 tables for males and females. From each table a measure of difference between the response rates for the control and the treated groups is computed. The researcher usually wants to know if the response-rate difference is zero for each table. If the tables are homogeneous, the researcher can generalize from a statement concerning an average to a statement concerning each table. If tables are not homogeneous, homogeneous subsets of the tables should be described separately. This paper presents tests for homogeneity and illustrates their use. 11 refs., 6 tabs.

23072 (CONF-870163—) **Mechanisms of radiation interaction with DNA: Potential implications for radiation protection.** (USDOE Office of Energy Research, Washington, DC. Office of Health and Environmental Research). Jan 1988. 184p. NTIS, PC A09/MF A01; 1; GPO Dep. Order Number DE88005314/JAW.

From DOE/CEC workshop on mechanisms of radiation interaction with DNA; San Diego, CA, USA (21 Jan 1987).

The Office of Health and Environmental Research (OHER) of the US Department of Energy conducts a broad multidisciplinary research program which includes basic biophysics, biophysical chemistry, molecular and cellular biology as well as experimental animal studies and opportunistic human studies. This research is directed at understanding how low levels of radiation of various qualities produce the spectrum of biological effects that are seen for such exposures. This workshop was entitled "Mechanisms of Radiation Interaction with DNA: Potential Implications for Radiation Protection." It ws jointly sponsored by the Department of Energy and the Commission of European Communities. The aim of the workshop was to review the base of knowledge in the area of mechanisms of radiation action at the DNA level, and to explore ways in which this information can be applied to the development of scientifically sound concepts and procedures for use in the field of radiation protection. The overview of research provided by this multidisciplinary group will be helpful to the Office in program planning. This report includes a summary of the presentations, extended abstracts, the meeting agenda, research recommendations, and a list of participants. Individual papers are processed separately for the data base.

23073 (CONF-871101—77-FP) **Internally deposited fallout from the Chernobyl reactor accident.** Schlenker, R.A.; Oltman, B.G.; Lucas, H.F. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 7p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88005997/JAW.

From Joint meeting of the American Nuclear Society and the Atomic Industrial Forum; Los Angeles, CA, USA (15 Nov 1987).

Measurements of fallout radioactivity were made in the thyroid region, abdomen, whole body, or urine of 96 persons who were in eastern Europe at the time of the Chernobyl reactor accident or who went there shortly afterward. The most frequently en-

countered radionuclides were ^{131}I, /sup 134,137/Cs, and $^{103}Ru/^{103}Rh$. The median ^{131}I activity in the thyroids of 42 subjects in whom radioiodine was detected and who were in Europe when the accident began was projected as 42 nCi the day the accident began. The median total body activity of ^{134}Cs in 40 subjects in which it was detected was 1.7 nCi upon arrival in the US. For 51 subjects with detectable ^{137}Cs burdens, the total body activity was 4.6 nCi. The risk of fatal thyroid cancer is less than 3×10^{-6} for nearly all subjects in this series. The risk of fatal cancer from /sup 134,137/Cs for subjects with cesium exposures similar to the ones observed by us, but who remained in Europe, is estimated as 1.4×10^{-6} to 4.2×10^{-5} with 95% of the risk attributable to ^{137}Cs. 5 refs., 4 tabs.

23074 **(CONF-880404—5) Twelve years of neutron personnel dosimetry intercomparison studies at Oak Ridge National Laboratory: What have we learned?.** Swaja, R.E. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004335/JAW.

From 7. international congress of the International Radiation Protection Association; Sydney, Australia (10 Apr 1988).

To provide an opportunity for dosimetrists to test and calibrate their personnel neutron monitoring systems in a variety of incident radiation fields, the staff of the Dosimetry Applications Research (DOSAR) Facility at the Oak Ridge National Laboratory (ORNL) has conducted personnel dosimetry intercomparison studies (PDIS) periodically since 1974 and annually since 1976 (Si82, Sw87). During these studies, personnel dosimeters are mailed to ORNL, mounted on phantoms and exposed to low-level (less than 15 mSv) dose equivalents in mixed-radiation fields mainly produced using the Health Physics Research Reactor (HPRR) at ORNL (Au65), and then returned to the participants for evaluation. Reported dose equivalents are compared to reference values provided by the DOSAR staff and to results reported by individual organizations which made measurements under identical conditions. These intercomparisons, which require no fee and are open to any organization interested in external personnel dosimetry, have provided more data concerning neutron dosimeter performance characteristics in mixed-radiation fields than any other periodic open test program conducted to date. The following text presents a summary and analysis of neutron dose equivalent measurements reported for the seventh through twelfth intercomparisons (1981-1986) using the HPRR as the source of radiation. Particular factors examined include low dose equivalent sensitivity and measurement accuracy for the basic types of neutron personnel dosimeters. 5 refs., 1 fig.

23075 **(CONF-880455—2) Screening model for assessing doses from radiological accidents.** Sjoreen, A.L.; Athey, G.F.; Sakenas, C.A.; McKenna, T.J. (Oak Ridge National Lab., TN (USA); Phoenix Associates, Bethesda, MD (USA); Nuclear Regulatory Commission, Washington, DC (USA)). 1988. Contract AC05-84OR21400. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004737/JAW.

From Conference of the Society of Computer Simulation; Orlando, FL, USA (18 Apr 1988).

A new dose assessment model, called RASCAL, has been written for the US Nuclear Regulatory Commission (NRC) for use during response to emergencies. RASCAL is designed to provide rough estimates of the health effects from a radiological accident in progress and only limited information is available. RASCAL will be used by the NRC personnel who report to the site of a nuclear accident to conduct an independent evaluation of dose projections. It was written to correct the technical and operational problems in NRC's previous model and to be more appropriate to the personal computers presently in use by the NRC. The model has been constructed to be easy to modify, with separate modules for estimation of the quantity of radioactivity released, its transport through the atmosphere, and the resulting radiologic dose to man. RASCAL results can be displayed in graphical or ASCII form. 4 refs.

23076 (DOE/ER/60281—3, pp vp, Paper 1) **Molecular mechanisms of misrepair mutagenesis: Progress report, January 1, 1985-October 31, 1987.** Lawrence, C.W. 1988. NTIS, PC A03/MF A01. Order Number DE88005906/JAW.

In [Studies of molecular biology: Final report].

Seeking to understand the molecular mechanisms responsible for misrepair mutagenesis in E. coli and yeast is the long-term aim of this project. New mutations in yeast that block induced mutagenesis were characterized. Single-stranded DNA vector molecules that contain a single defined premutagenic lesion at a single defined site were constructed. Specifically, several new mutations, notably rev6, rev7 and ngm2, were isolated. Sequence analysis of the cloned REV3 gene has revealed a single open reading frame of 4512 nucleotides that encodes a putative protein with highly significant homology to Epstein-Barr viral DNA polymerase. The protein also contains a completely conserved sequence of 6 amino acids found in all eukaryote DNA polymerases. Since the REV3 restriction map is different from that for POL1, which encodes DNA polymerase I of yeast, we suspect that REV3 encodes polymerase II. The association of such a mutant phenotype with a DNA polymerase is novel, and the implication for studies of eukaryote DNA replication in general is considerable.

23077 **(GB-INIS—123) Corporate plan 1987/1988 to 1990/1991.** (National Radiological Protection Board, Chilton (UK)). Apr 1987. 27p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752353/JAW.

The previous year's Plan forecast the increased effort needed to support advisory bodies such as COMARE (Committee on the Medical Aspects of Radioactivity in the Environment) and the extra-mural support now being given to epidemiological studies; it was not able to predict the disruptive effect of the accident at Chernobyl which had marked financial and technical implications for the year's work and has changed the emphasis of some of the future programmes. The area concerning organisational arrangements for dealing with accident consequence modelling has increased. The need for arresting any downward trend in public exposure review and environmental surveillance is also emphasised.

23078 **(ICRP—51) Data for use in protection against external radiation. A report of a task group of Committee 3 of the International Commission on Radiological Protection.** (International Commission on Radiological Protection, Sutton (UK)). 1987. 135p. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88752354/JAW.

The objective of this report is to provide information and advice on the relationships between radiometric, dosimetric and radiation protection quantities for external radiation and on their practical utilization. Data are presented under the following headings: Recommendations for the limitation of external radiation, determination of dose distributions in the human body, conversion coefficients for idealized circumstances, (including data for photons, muons, pions, neutrons, protons and electrons), application of the conversion coefficients. (U.K.).

23079 **(INIS-BR—921) Citrus gemma in vitro irradiation and cells culture.** Santos Passos, R.C. dos; Tulmann Neto, A. (Sociedade Brasileira de Genetica, Sao Paulo). 1987. 1p. (In Portuguese). (CONF-8704263—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701462/JAW.

From 5. meeting of geneticists from Sao Paulo; Piracicaba, Brazil (24 Apr 1987).

Published in summary form only.

23080 **(INIS-BR—922) Ultraviolet radiation inactivation and photoreactivation in Sciara embryos.** Guatimosim, V.M.B.; Perondini, A.L.P. (Sociedade Brasileira de Genetica, Sao Paulo). 1987. 1p. (In Portuguese). (CONF-8704263—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701463/JAW.

From 5. meeting of geneticists from Sao Paulo; Piracicaba, Brazil (24 Apr 1987).

23081 (INIS-mf—10846, pp 51) **Plutonium-239 determination in biomaterials.** Novakova, E.; Kerteva, A.; Petkov, T. (Meditsinska Akademiya, Sofia, Bulgaria). Nov 1984. (In Bulgarian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

23082 (INIS-mf—10846, pp 41) **Possibility for modification of radiobiological effect by constant magnetic field.** Mileva, M.; Bulanova, M.; Ivanov, B.; Pantev, T. (Meditsinska Akademiya, Sofia, Bulgaria). Nov 1984. (In Bulgarian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

23083 (INIS-mf—10846, pp 51) **Some possibilities of mammalian organisms response on combined effects of ionizing and nonionizing agents.** Paskalev, Z. (Moskovskij Gosudarstvennyj Univ., USSR). Nov 1984. (In Bulgarian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

23084 (INIS-mf—10846, pp 52) **Study of alternations of the dielectric parameters of blood plasma in rats due to combined effect of incorporated strontium-89 phosphoroorganid pesticides and VHF-radiowaves.** Paskalev, Z. (Meditsinska Akademiya, Sofia, Bulgaria). Nov 1984. (In Bulgarian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

23085 (INIS-mf—10846, pp 52) **Investigation of the kinetics of strontium-85 and cerium-144 at combined treatment with phosphoroorganic pesticides and VVHF-waves.** Paskalev, Z.; Peyankov, I. (Meditsinska Akademiya, Sofia, Bulgaria). Nov 1984. (In Bulgarian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

23086 (INIS-mf—10846, pp 23) **Application of the chromosome analysis for assessment of radiation damages.** Ivanov, B.; Bulanova, M.; Mileva, M.; Georgieva, I.; Praskova, L. (Meditsinska Akademiya, Sofia, Bulgaria). Nov 1984. (In Bulgarian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

23087 (INIS-mf—10846, pp 30) **Effect of external gamma-radiation and radiomodifying agents on the behaviour of unsoluble radionuclides in gastrointestinal tract.** Kiradzhiev, G.; Slavov, S.; Miloslavov, V. (Meditsinska Akademiya, Sofia, Bulgaria). Nov 1984. (In Bulgarian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

23088 (INIS-mf—10846, pp 60) **Gamma-spectrometric determination of resorption and passage parameters of orally intaken radiostrontium.** Slavov, Sl.; Kirapzhiev, V.; Miloslavov, V. Nov 1984. (In Bulgarian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

23089 (INIS-mf—10846, pp 60) **Rat phantom for the determination of ^{137}Cs in vivo penetration through wounds.** Simova, G.; Boyadzhiev, A.; Shopov, P.; Dimov, Ya. (Meditsinska Akademiya, Sofia, Bulgaria). Nov 1984. (In Bulgarian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

23090 (INIS-mf—10846, pp 69) **Seasonal dose distribution of the population in the region of Kozloduj NPP.** Khristova, M. (Meditsinska Akademiya, Sofia, Bulgaria). Nov 1984. (In Bulgarian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

23091 (INIS-mf—10846, pp 11) **Radiation hazards evaluation for man and modification of the notion ionizing radiation dose.** Vasilev, G. (Meditsinska Akademiya, Sofia, Bulgaria). Nov 1984. (In Bulgarian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

23092 (INIS-mf—10846, pp 11) **Estimation approach to the hazards from environmental radioactive contamination based on expected collective effective equivalent doses.** Vasilev, G. (Meditsinska Akademiya, Sofia, Bulgaria). Nov 1984. (In Bulgarian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

23093 (INIS-mf—10846, pp 26) **Occupational irradiation from external sources in the 1981-1983 period according to the supervision system data.** Karadzhov, A.; Velikov, V. (Meditsinska Akademiya, Sofia, Bulgaria). Nov 1984. (In Bulgarian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

23094 (INIS-mf—10846, pp 67) **Necessity for prohibition of some X-ray examination and radon spa-treatment of children.** Uzunov, I. (Sofia Univ., Bulgaria). Nov 1984. (In Bulgarian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

23095 (INIS-mf—10846, pp 69) **Possibility for optimization of radiation monitoring in the region of the Kozloduj NPP.** Khristova, M.D.; Paskalev, Z. (Meditsinska Akademiya, Sofia, Bulgaria). Nov 1984. (In Bulgarian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

23096 (INIS-mf—10846, pp 76) **Medical irradiation of the population from conventional X-rays therapy during 10 years.** Fulea, C.; Ramboiu, S.; Ciurdareanu, S.; Salagean, M.; Postescu, M. (Institutul de Medicina si Farmacie, Cluj, Romania). Nov 1984. NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

23097 (INIS-mf—10846, pp 81) **Population gonad dose from natural external gamma radiation in Transilvania.** Moscy, I.; Fulea, C. (Institutul de Medicina si Farmacie, Cluj, Romania). Nov 1984. NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

23098 (INIS-mf—10846, pp 38) **Low background, high resolution gamma spectroscopy for determination of technogenic radionuclides in plant samples.** Marinov, V.; Botsova, L.; Grigorov, T.; Boyadzhiev, L.; Kirov, K. (Akademiya na Selskostopanskite Nauki, Sofia, Bulgaria). Nov 1984. (In Bulgarian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

23099 (INIS-SU—432, pp 535) **Effect of vaccination with engoneous N-tropic virus of mice on thymoma development, induced by γ-irradiation in mice of various line.** Mazurenko, N.A.; Yakovleva, L.S.; Shcherbak, N.P.; Pavlovskaya, A.I.; Zueva, I.N. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

23100 **(INIS-XN—109) 14 June No. 1157. Regulations on work involving exposure to radiation.** (International Atomic Energy Agency, Vienna (Austria)). 14 Jun 1985. 2p. (In Norwegian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701092/JAW.

These Regulations were made in implementation of the Act of 4 February 1977 on the protection of workers and their working environment and repeal the Regulations of 31 March 1978 dealing with the same question. The Regulations provide that employees may not be assigned to work involving ionizing radiation where the effective dose equivalent exceeds 50 mSv over a period of twelve months. For adolescents between sixteen and eighteen years of age, the limit is set at 5 mSv for that same period. Pregnant women and children under sixteen may not be exposed to radiation. Finally, all persons exposed to radiation in the course of their work must have such exposure continuously monitored, by personal dosimeters or by other means. (NEA).

23101 **(LBL—22300) Biology and Medicine Division: Annual report 1986.** (Lawrence Berkeley Lab., CA (USA)). Apr 1987. Contract AC03-76SF00098. 292p. NTIS, PC A13/MF A01; 1; GPO Dep. Order Number DE87009280/JAW.

The Biology and Medicine Division continues to make important contributions in scientific areas in which it has a long-established leadership role. For 50 years the Division has pioneered in the application of radioisotopes and charged particles to biology and medicine. There is a growing emphasis on cellular and molecular applications in the work of all the Division's research groups. The powerful tools of genetic engineering, the use of recombinant products, the analytical application of DNA probes, and the use of restriction fragment length polymorphic DNA are described and proposed for increasing use in the future.

23102 (N—88-13774, pp vp) **TOMS as a monitor of the ultraviolet radiation environment: applications to photobiology.** Frederick, J.E. Dec 1987. NTIS, PC A06/MF A01. (NASA-CP—2497; REPT—87B0206; NAS—1.55:2497; CONF-8609399—).

From Scientific and operational requirements for TOMS data; Greenbelt, MD, USA (10 Sep 1986).

The flux of biologically relevant ultraviolet radiation that reaches the surface of the Earth varies with the ozone amount, surface reflectivity, and cloudcover. The Total Ozone Mapping Spectrometer (TOMS) provides information relevant to all three items. A recent application of satellite-based ozone measurements has been to develop climatologies of the biologically significant UV-B radiation reaching the Earth's surface. A growing body of research suggests that UV-B radiation tends to suppress the immune system of laboratory mice. At tropical latitudes, it is likely that parasitical diseases develop most readily in people who have experienced immune system suppression from UV-B exposure. The computed distribution of surface radiation combined with information on disease incidence may clarify the role of UV-B as a suppressor of the human immune system. TOMS used in conjunction with radiative transfer calculations can provide information of relevance in photobiology.

23103 **(N—88-14058) Preliminary estimates of galactic cosmic ray exposures for manned interplanetary missions.** Wilson, J.W.; Townsend, L.W.; Atwell, W. (National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center). Oct 1987. 15p. (NASA-TM—100519; NAS—1.15:100519). NTIS, PC A03/MF A01.

Preliminary estimates of radiation exposures resulting from galactic cosmic rays are presented for interplanetary missions. The calculations use the Naval Research Laboratory cosmic ray transport code. The heavy ion portion of the transport code can be used with any number of layers of target material, consisting of up to five different constituents per layer. The nucleonic portion of the transport code can be used with any number of layers of target material of arbitrary composition except hydrogen. Calculated galactic cosmic ray particle fluxes, doses, and dose equivalents behind various thicknesses of aluminum shielding are presented for solar maximum and solar minimum periods.

23104 **(NEI-DK—64) Cancer incidence among workers of the Danish Construction Corporation (DDC) employed at the Thule Air-Base Greenland 1963-1971. Report No. 2, case No. 86/28.** Storm, H.H.; Engholm, G.; Juel, K. (Landsforeningen til Kraeftens Bekaempelse, Copenhagen (Denmark). Cancerregisteret). Nov 1987. 31p. (In Danish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752047/JAW.

Cancer risk for persons employed at the Thule air-base during the cleaning period 21.01-19.09 1968 after the crash of a B52 bomber wit hydrogen bombs on board, is compared to risk in the Danish male population and in the group employed at Thule air-base in other periods. Pulmonary cancer, testide cancer and melanoma were assessed to occur more often than in control group, but were not significantt related to radioactivity effects. Generally the investigation of DCC employees indicates that cancer risk is not augmented in relation to radioactive material exposure. Further evaluation of reasons for the occurrence of some cancer forms has to include the socio-economic background and life conditions of people employed at Thule 1963-71. (EG).

23105 **(NEI-DK—65) Mortality and hospitalization incidence among employees of the Thule Air-Base 1963-1971. Partial report on Thule case.** Juel, K. (Dansk Inst. for Klinisk Epidemiologi, Copenhagen). 1987. 85p. (In Danish). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88752048/JAW.

January 21th 1968 an American B52 bomber with nuclear weapons aboard crashed close to the Thule air-base on Greenland. This report considers mortality and hospitalization incidence among the 4322 persons employed at the air-base. (EG).

23106 **(NIRS-AR—29) Annual report of National Institute of Radiological Sciences of the fiscal year 1985.** (National Inst. of Radiological Sciences, Chiba (Japan)). May 1986. 220p. (In Japanese). NTIS (US Sales Only), PC A10/MF A01. Order Number DE87703015/JAW.

The activities of National Institute of Radiological Sciences in fiscal year 1985 was carried out on the basis of the total budget of 5,550.597 million yen and 404 regular staff positions. The ordinary research was carried out on 65 subjects, and the results of internationally high level were obtained. The special research was carried out by selecting four subjects: the biological effect of tritium accompanying fusion reactor development, the probabilistic effect of radiation and risk evaluation, the evaluation of exposure to environmental radiation, and the medical application of heavy-particle beams. In addition to these, the specified research and the research based on the science and technology promotion coordination expense were carried out. Research was advanced by the collective-discipline method, and good results were obtained. Much of this is due to the efforts of Administration Division, Technical Division, and Hospital Division, as well as Research Division. The total number of trainees who finished various courses reached 3651 in fiscal year 1985, and this contributed largely to the protection from and the utilization of radiation in Japan. Recently, the importance of international exchange has increased, and efforts have been exerted to take part in various international activities overcoming all difficulties.

23107 **(NRPB-R—213) Measurements of the body content of radioactive caesium in residents of Yorkshire.** Bailey, M.R.; Dodd, N.J.; Etherington, G.; Hudson, A.P.; Wheatley, J. (National Radiological Protection Board, Chilton (UK)). Dec 1987. 24p. H.M. Stationery Office, London, price Pound 4.00.

During November 1987, measurements of the body content of radioactive caesium (caesium-134 + caesium-137) were made in Yorkshire on nearly 400 people, of whom about 250 live in the Ilkley-Skipton area. The objective was to obtain information on levels of radioactive caesium in people in the area, to complement measurements on the environment and foodstuffs. Body contents of radioactive caesium were measured with a relatively simple, mobile whole-body monitor. In almost all cases the amount of radioactive caesium in the body was less than the limit of detection of the measurement technique (typically 370 Bq) and in all cases below 500 Bq. Results indicate the average level of radioactive caesium in the measured population is less than that generally found in those areas of the UK where there was extensive enhanced deposition of Chernobyl fallout, and probably no greater than that typical of southern and eastern parts of the UK (200 Bq). Enhanced levels of radiocaesium were not found in people who regularly consume locally produced milk, lamb or vegetables. The results confirm that there is no cause for special concern in this area.

23108 **(PNL-SA—14495) Relationship of radiation sensitivity and aberrant DNA synthesis in repair deficient CHO cells.** Newman, C.N.; Hagler, H.; Miller, J.H. (Pacific Northwest Lab., Richland, WA (USA)). Nov 1986. Contract AC06-76RL01830. 15p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005679/JAW.

Comparison of alkaline sucrose gradient profiles of pulse-labeled DNA from a normal CHO cell line and its radiation-sensitive mutant, xrs-5, reveals significant differences in the replicon elongation/maturation process in these two cells. During a one hr period of growth subsequent to labeling, the molecular weight of pulse-labeled DNA from the mutant cell increases considerably more rapidly than that of the parent cell. For xrs-5, the presence of 2 mM deoxycytidine (CdR) in the culture medium reduces the replication rate to one approaching that of the parent cell growing in the standard medium. Corresponding uv resistance of the mutant likewise increases to nearly that of the parent cell line. These results suggest that the locus conferring radiation sensitivity to xrs-5 affects the DNA replisome complex and that replicative activity and radiation sensitivity are jointly modulated by CdR. 19 refs., 4 figs.

23109 **(PNL-SA—15056) Characterization of space radiation environment in terms of the energy deposition in functionally important volumes.** Braby, L.A.; Metting, N.F.; Wilson, W.E.; Ratcliffe, C.A. (Pacific Northwest Lab., Richland, WA (USA)). Jan 1988. Contract AC06-76RL01830. 10p. (CONF-8711149—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005627/JAW.

From Conference on high energy radiation background in space; Sanibel Island, FL, USA (3 Nov 1987).

Since the damage which initiates detrimental effects occurs in a small site (semiconductor junctions, or biological cell nuclei), these differences in spatial distribution of ionization maybe the relevant factor controlling the effectiveness of different radiations. Again, when the appropriate cross section data are available Monte Carlo methods can be used to simulate the positions of all ionizations and excitations produced by a typical charged particle. This calculated track structure must interact with the biological or electronic entity in which it occurs to produce the effect. However, we do not know the mechanisms of this interaction and thus cannot specify which characteristics of the charged particle track are responsible for the relevant damage. From track structure we can obtain the spectrum of energy deposition in small volumes which may be relevant to the processes of concern. This has lead to a new approach to dosimetry, one which emphasizes the stochastic nature of energy deposition in small sites, known as microdosimetry. 6 refs., 4 figs.

23110 **Molecular analysis of heritable mouse mutations.** Rinchik, E.M. (Oak Ridge National Lab., TN). *Environmental Health Perspectives;* **74**: 41-48(Oct 1987).

Germ-like mutations of the mouse have for years comprised one class of biological markers for mammalian reproductive and developmental toxicology. Understanding the molecular nature of mutations and the mechanisms by which mutations are translated into specific (and often complex) phenotypes, however, still looms as a major goal of mammalian biology. Molecular genetic analysis of heritable mouse mutations constitutes a significant, experimentally malleable strategy for relating genomic DNA structure to genic expression and function in mammals. The integrated use of recombinant DNA technology, which allows both the identification and analysis of expression of single genes, and classical genetic and cytogenetic analysis, which allow the important correlation between basic DNA defects and the organismic consequences of such defects, has been crucial to this strategy. Some of the approaches (e.g., specific-gene cloning, random-clone analysis of genomic regions, insertional mutagenesis) for studying the nature and effect of both mutations and their wild-type counterparts that have resulted from this integration of genetic analysis and molecular biology have been applied to many loci within the murine genome. Studies of the nature and effects of a complex set of radiation-induced mutations at the dilute-short ear (d-se) region of chromosome 9, a specific example of this type of integrated analysis, are discussed.

23111 **Biomarkers in the detection of human heritable and germinal mutagenesis.** Mendelsohn, M.L. (Lawrence Livermore National Lab., CA). *Environmental Health Perspectives;* **74**: 49-53(Oct 1987). Contract W-7405-ENG-48.

An important potential use of biomarkers in human toxicology is the detection of induced mutational events in offspring and germ cells of exposed individuals. The importance, of course, is in risk estimation and the identification and prevention of exposure conditions that are harmful to the human genome. The challenge is to discover methods of sufficient power to find the rare, random, mutational events and to discriminate such events from other sources of molecular variation. Finding mutations is essentially a search for disorder. Normal biomarkers are inherently unsuitable in a positive search for disorder; instead one must either use abnormal markers or be prepared to search negatively, i.e., to look for and somehow validate the rare absence of a normal marker. In spite of these difficulties, there is progress to report and hope of future success in this field.

23112 The influence of 3-aminobenzamide on chemical and radiation induced mutagenesis. Brooks, A.L.; Seiler, F.A. (Inhalation Toxicology Research Institute, Albuquerque, NM 87185). pp 87 of Thirty-fifth annual meeting of the Radiation Research Society (Abstracts). Philadelphia, PA; Radiation Research Society (1987). (CONF-870221—). Contract AC04-76EV01013.

From 35. annual meeting of the Radiation Research Society; Atlanta, GA, USA (22 Feb 1987).

Radiation exposure followed by mutagenic chemicals produced fewer mutations in a CHO/HGPRT mutation assay than were predicted by an additive model. The decrease was postulated to be related to radiation-induced alterations in repair of genetic damage. To evaluate this hypothesis, CHO cells were exposed to 500 rad of x-rays followed two hours later by treatment with 0.5 μg/ml of 3-methylcholanthrene. Mutations were measured at the HGPRT gene locus. Before, during, or after the radiation and chemical exposures, cells were treated with 9.5 mM 3-aminobenzamide (3AB), an inhibitor of poly-ADP-ribosylation. Cells exposed to x-rays followed by 3AB treatment had reduced cell survival. Incubation of cells with 3AB between radiation and chemical exposure resulted in reduced cell survival and highly variable mutagenic response. These, which suggest that repair enzymes play a role in radiation-induced changes in cell survival, but may have little influence on chemically induced mutations, are discussed relative to potential synergistic or antagonistic interactions of radiation and chemical mutagens.

23113 Quantitation of thymine radiolysis products in DNA x-irradiated in vitro. Hubbard, K.; Kow, Y.W.; Ide, H.; Melamede, R.; Wallace, S.S. (Dept. of Microbiology and Immunology, New York Medical College, Valhalla, NY 10595). pp 98 of Thirty-fifth annual meeting of the Radiation Research Society (Abstracts). Philadelphia, PA; Radiation Research Society (1987). (CONF-870221—).

From 35. annual meeting of the Radiation Research Society; Atlanta, GA, USA (22 Feb 1987).

High or low concentrations of PM2 DNA were x-irradiated either in Tris-EDTA or in phosphate buffer in air. After irradiation, DNA damage was monitored simultaneously by the anti-thymine glycol (anti-TG) antibody assay as well as the Escherichia coli endonuclease III (endo III) nicking assay. When PM2 DNA was x-irradiated in air in Tris-EDTA at high concentrations, a dose dependent increase of anti-TG binding sites, acetol fragments, and endo III sensitive sites were observed. When PM2 DNA was irradiated in air in phosphate buffer, both the number of acetol fragments and endo III sensitive sites were 5 to 10 fold higher than the number observed when the DNA was irradiated in Tris-EDTA. The authors are presently corroborating these results by HPLC analysis of the products released after endo III digestion of x-irradiated DNA. The implications of these data with respect to thymine glycol production are discussed.

23114 Radiation-induced mutagenicity in repair deficient Chinese hamster ovary (CHO) mutants. Tesmer, J.G.; Saunders, E.H.; Chen, D.J. (Genetics Group, Life Sciences Div., Los Alamos National Lab., Los Alamos, NM 87545). pp 88 of Thirty-fifth annual meeting of the Radiation Research Society (Abstracts). Philadelphia, PA; Radiation Research Society (1987). (CONF-870221—).

From 35. annual meeting of the Radiation Research Society; Atlanta, GA, USA (22 Feb 1987).

To determine if there is a relationship between DNA double-strand break repair and mutagenicity the authors utilized two x-ray sensitive mutants of Chinese hamster ovary cells along with the parental line K1. The two mutant lines xrs-5 and xrs-6, which have different DSB repair capabilities, were used to determine cell killing and 6-thioguanine resistance (6TG/sup r/) mutation frequencies induced by either x-rays of α-particles, x-ray survival data indicated the two mutant lines have similar sensitivity and are 5-7 fold more sensitive than the parental line K1. The mutant lines are also sensitive to α-particles but to a lesser extent. The authors' 6TG mutation data indicated that the two mutant lines are hypermutable. When mutation frequencies were plotted against the log of survival, mutation frequency at a given survival level was greater in mutant cell population than in parental K1 cells. Their results support the notion that repair of DSB play an important role in the expression of radiation-induced cell killing and mutagenicity.

23115 The intranuclear environment is highly protective against γ-irradiation induced DNA strand breaks. Flick, M.B.; Krisch, R.E. (Dept. of Radiation Therapy, Univ. of Pennsylvania, School of Medicine, Philadelphia, PA 19104). pp 99 of Thirty-fifth annual meeting of the Radiation Research Society (Abstracts). Philadelphia, PA; Radiation Research Society (1987). (CONF-870221—).

From 35. annual meeting of the Radiation Research Society; Atlanta, GA, USA (22 Feb 1987).

Simian virus 40 (SV40) particles or pure DNA were gamma-irradiated intra- or extracellularly at 25°C or -75°C. Single strand breaks (SSB) and double strand breaks (DSB) were assayed simultaneously using neutral gel electrophoresis to separate superhelical (no breaks), nicked circle (SSB) and linear (DSB) SV40 DNA molecules. As expected, the efficiencies of break induction at -75°C do not vary greatly under the various conditions of irradiation. However at 25°C, the efficiencies of induction of SSB or DSB are about 5-fold lower for intranuclear viral DNA compared to extracellularly irradiated SV40 particles or DNA. The authors conclude that the intranuclear environment is highly protective against DNA breakage resulting from ionizing radiation. This protection is similar to that afforded by ultra low temperatures.

23116 Mechanisms of chemical modification of neoplastic cell transformation by ionizing radiation. Yang, T.C.; Tobias, C.A. (Biology and Medicine Div., Univ. of California, Lawrence Berkeley Lab., Berkeley, CA 94720). pp 39 of Thirty-third annual meeting of the Radiation Research Society (Abstracts). Philadelphia, PA; Radiation Research Society (1985). (CONF-8505113—). Contract AC03-76SF00098.

From 33. annual scientific meeting of the Radiation Research Society; Los Angeles, CA, USA (5 May 1985).

During space travel, astronauts will be continuously exposed to ionizing radiation; therefore, it is necessary to minimize the radiation damage by all possible means. The authors' studies show that DMSO (when present during irradiation) can protect cells from being killed and transformed by X rays and that low concentration of DMSO can reduce the transformation frequency significantly when it is applied to cells, even many days after irradiation. The process of neoplastic cell transformation is a complicated one and includes at least two different stages: induction and expression. DMSO apparently can modify the radiation damage during both stages. There are several possible mechanisms for the DMSO effect: (1) changing the cell membrane structure and properties; (2) inducing cell differentiation by acting on DNA; and (3) scavanging free radicals in the cell. Recent studies with various chemical agents, e.g., 5-azacytidine, dexamethane, rhodamin-123, etc., indicate that the induction of cell differentiation by acting on DNA may be an important mechanism for the suppression of expression of neoplastic cell transformation by DMSO.

23117 Studies on LET dependence of the radioprotective effect of WR 2721. Afzal, S.M.J.; Mahlmann, L.J.; Ainsworth, E.J. (Biology and Medicine Div., Lawrence Berkeley Lab., Univ. of California, Berkeley, CA 94720). pp 43 of Thirty-third annual meeting of the Radiation Research Society (Abstracts). Philadelphia, PA; Radiation Research Society (1985). (CONF-8505113—).

From 33. annual scientific meeting of the Radiation Research Society; Los Angeles, CA, USA (5 May 1985).

Reported here are the radioprotective effects of WR 2721 on the colony forming units-spleen (CFU-S) exposed to the heavy-ion beams with dose-averaged LET/sub ∞/ values ranging from 26 to 260 keV/μm. CB/sub 6/F/sub 1/ mice were given total body doses of /sup 20/Ne, /sup 28/Si, /sup 40/Ar and /sup 56/Fe ions in the plateau region of the Bragg curve 30 min. after an i.p. dose of 400 mg/kg of WR 2721. Marrow collected 30 to 90 min. after irradiation was transplanted into supralethally irradiated syngeneic recipients and the CFU-S survival curves were computed. The magnitude of protection afforded by WR 2721 is significant at 26, 51 and even 135 keV/μm LET values where the data were collected with /sup 20/Ne, /sup 28/Si and /sup 40/Ar ions, respectively. The largest component of protection is the slope change, where at LET

values of 26 and 51 keV/μm the DMFs are 2.1 and 2.3, respectively, which are very close to the gamma value of 2.4 (gamma LET≅0.8 keV/μm). Protection, however, decreased with increase in LET from 51 to 135 keV/μm. Following irradiation with very high-LET (260 keV/μm) /sup 56/Fe ions, WR 2721 did not change the slope of the survival curve, but did displace it slightly to a higher dose range.

23118 **Cell-cycle-dependent repair of heavy-ion damage.** Blakely, E.A.; Chang, P.Y.; Lommel, L.; Tobias, C.A. (Biology and Medicine Div., Lawrence Berkeley Lab., Univ. of California, Berkeley, CA 94720). pp 47 of Thirty-third annual meeting of the Radiation Research Society (Abstracts). Philadelphia, PA; Radiation Research Society (1985). (CONF-8505113—). Contract AC03-76SF00098.

From 33. annual scientific meeting of the Radiation Research Society; Los Angeles, CA, USA (5 May 1985).

Synchronized human T-1 cells have been used to investigate the G1-phase age dependence of repair of potentially lethal damage (PLDR). The cells were irradiated with single doses of either 225 kVp X rays or Bragg-peak 425 MeV/μ neon ions at ages between 1.5 and 6.0 hrs after mitotic selection, and then either trypsinized and plated immediately, or held at 37°C for 6 hrs in PBS, or PBS containing 60μM of the DNA-polymerase-inhibitor 1-β-D-arabinofurano-syladenine (β-araA) before trypsinization and plating. Delayed plating showed significant PLDR at all ages irradiated with X rays, with the increase of survival varying between 2- to 8-fold. At equivalent survival levels, there was a reduced capacity for PLDT at each cell age irradiated with neon ions. In early G1 after neon-ion exposures, delayed plating actually enhanced cell killing; whereas, in late G1 the survival increased about 2-fold. β-araA almost completely eliminated the PLDR after X rays, reducing the survival to that measured with immediate plating. β-araA slightly enhanced neon-ion cell killing at all cell ages.

23119 **Long term recovery from radiation-induced damage in the rat kidney: The effect of nephrectomy.** Van der Kogel, A.J.; Kuijpers, W.C. (Life Sciences Div., Los Alamos National Lab., Los Alamos, NM 87545). pp 32 of Thirty-third annual meeting of the Radiation Research Society (Abstracts). Philadelphia, PA; Radiation Research Society (1985). (CONF-8505113—).

From 33. annual scientific meeting of the Radiation Research Society; Los Angeles, CA, USA (5 May 1985).

The kidney, as one of the most radiosensitive critical organs in the abdomen, is often dose limiting in large field radiotherapy. Repair characteristics of the kidney are similar to other late responding tissues, with a large capacity for repair of subeffective damage in multifraction exposures. The presence of a time-dependent recovery process is still much disputed. The differences found may be species related or, more probably, may depend on the experimental model used. This has also led to opposing views on the pathogenesis of kidney damage being primarily of glomerular or of tubular origin. The authors studied the effect of unilateral nephrectomy at time-intervals from four weeks before to six months after irradiation, assuming that nephrectomy induces expression of latent damage. Glomerular- and tubular-related functions were measured. Preliminary results do not indicate a significant recovery of potentially effective damage up to three months after irradiation. In split-dose experiments, the ED/sub 50/ for a 42-day interval was significantly larger than for a 1-day interval for glomerular, but not fur tubular function related endpoints. This suggests that long-term recovery of subeffective damage occurs for glomerular functions, but not, or to a lesser extent, for tubular functions of the rat kidney.

23120 **Suppression of radiation mutagenesis by dactinomycin in Chinese hamster cells.** Tokita, N.; Capenter, S.G.; Chen, D.J.; MacInnes, M.A.; Raju, M.R. (Life Sciences Div., Los Alamos National Lab., Los Alamos, NM 87545). pp 42 of Thirty-third annual meeting of the Radiation Research Society (Abstracts). Philadelphia, PA; Radiation Research Society (1985). (CONF-8505113—).

From 33. annual scientific meeting of the Radiation Research Society; Los Angeles, CA, USA (5 May 1985).

Dactinomycin (AMD) suppression of radiation mutagenesis was investigated using an in vitro mutation assay (6-thioguanine resistance) in Chinese hamster ovary cells. Cells were exposed to acute single doses of x rays followed by 1 hr-treatment with 0.1 or 1 μg/ml AMD. The cell survival curves plotted as a function of x-ray doses were similar for radiation alone and radiation plus AMD. The results suggest that AMD treatment was only slightly mutagenic, however, when given immediately after irradiation, it suppressed radiatiion mutagenesis at higher x-ray dose regions (below 10% survival levels). Higher AMD concentrations appeared more suppressive than lower concentrations. Dose-response data analyzed based on Poisson distribution models suggest the stochastic dependence of x-ray mutagenesis and AMD cytotoxity.

23121 **UV-induced mutagenesis in CHO-K1 cells is modulated by growth in presence of deoxycytidine.** Newman, C.N.; Miller, J.H. (Pacific Northwest Lab., Richland, WA 99352). pp 41 of Thirty-third annual meeting of the Radiation Research Society (Abstracts). Philadelphia, PA; Radiation Research Society (1985). (CONF-8505113—). Contract AC06-76RL01830.

From 33. annual scientific meeting of the Radiation Research Society; Los Angeles, CA, USA (5 May 1985).

Growth of CHO-K1 is normally in Ham's F-12 containing 10% fetal calf serum (Med. #1). The presence of 2mM CdR in Med #1 (Med. #2) results in a 5- to 10-fold reduction in the frequency of UV-induced HGPRT/sup -/mutations. Rates of /sup 3/H-TdR incorporation into DNA following exposure of cells pregrown in either medium were compared. While decreased rates were observed for at least 6 hr in all irradiated cells, those cells pregrown in Med. #2 incorporated only 1/3 s much radiolabel as cells in Med. #1, when each compared to its sham-irradiated control. TLC analysis of spent growth media suggest that cells in Med. #1 convert exogenous TdR to thymine which is poorly incorporated while cells in Med. #2 utilize exogenous TdR, intact. Exposure of cells to UV, which causes a several-fold expansion of the dTTP pool, probably dilutes the endogenous specific radioactivity of /sup 3/H-TdR in cells grown in Med. #2, accounting for the apparent lower incorporation rate. The absence of this dilution effect in Med. #1, as well as the concommitant degradation of exogenous TdR, together, suggest that the ultimate source of the DNA precursor, dTTP, differs in the two growth media. The authors hypothesize that this difference is responsible for the corresponding difference in UV-induced mutation frequencies.

23122 **Potentially lethal damage (PLD) repair in rat rhabdomyosarcoma tumors.** Afzal, S.M.J.; Tenforde, T.S.; Curtis, S.B. (Biology and Medicine Div., Lawrence Berkeley Lab., Univ. of California, Berkeley, CA 94720). pp 47 of Thirty-third annual meeting of the Radiation Research Society (Abstracts). Philadelphia, PA; Radiation Research Society (1985). (CONF-8505113—). Contract AC03-76SF00098.

From 33. annual scientific meeting of the Radiation Research Society; Los Angeles, CA, USA (5 May 1985).

Rat rhabdomyosarcoma tumor cells grown as monolayer cultures exhibit substantial recovery from PLD, but no repair can be measured in the in vivo tumors. As opposed to the rapid plating technique used in vitro, the in vivo experiments involve a lengthy procedure of tumor excision, dissociation and plating, during which a substantial amount of PLD repair could occur. The present study tests the hypothesis that PLD repair occurs in rhabdomysarcoma tumors, but cannot be detected when the excision assay technique is used to measure cell survival. Addition of a noncytotoxic concentration of the repair inhibitor, β-Ara-A, immediately after 20 Gy of X irradiation reduced the ultimate survival from 0.028 to 0.0053 (PLD repair inhibition factor = 5.3). Delaying the exposure of tumor cells to β-Ara-A for 1, 2, or 3 h after irradiation resulted in a progressive decrease of the repair inhibition factor to values of 2.5, 2.2, and 1.7, respectively. These results are consistent with the idea that repair of PLD is occurring in vivo but is not being detected by normal excision assay procedure.

23123 **The effect of radioprotectors on the radioresponse of CHO cells exposed to iodinated contrast medium.** Landis, M.R.; Wallen, C.A. (Univ. of Kansas, Lawrence, KS 66044). pp 44 of Thirty-third annual meeting of the Radiation Research Society (Abstracts). Philadelphia, PA; Radiation Research Society (1985). (CONF-8505113—).

From 33. annual scientific meeting of the Radiation Research Society; Los Angeles, CA, USA (5 May 1985).

The use of iodinated contrast medium (ICM) is necessary in many diagnostic procedures in order to visualize anatomic structures. ICM causes an increase in absorbed dose due to the increased photoelectric effect, presenting a dilemma in that to get better diagnostic information one also gets increased radiation cytotoxicity. A significant increase in cell kill can be measured, by a clonogenic assay, when cells are irradiated in the presence of 4% ICM (19 mg I/ml) with x-ray beams with an effective energy of 30-50 KeV. Dose enhancement factors as measured by the ratios of the slopes of the survival curves, range from 1.6 to 1.8. The present study investigates the feasibility of using radioprotectants as a means of preventing this dose enhancement. The effect(s) of the addition of several radioprotective agents WR-2721, DMSO, and Vitamin E was evaluated. For example, a 10 mM concentration of WR-2721 was found to virtually eliminate this enhanced killing. The combination of radioprotectants and ICM in diagnostic procedures may prove useful in reducing the hazards, such as carcinogenesis and mutagenesis, associated with many of these procedures.

23124 **Subcellular dose from I-125 Auger electrons.** Paschoa, A.S.; Yasui, L.; Wrenn, M.E. (Univ. of Utah, Bldg. 351, Salt Lake City, UT 84112). pp 34 of Thirty-third annual meeting of the Radiation Research Society (Abstracts). Philadelphia, PA; Radiation Research Society (1985). (CONF-8505113—).

From 33. annual scientific meeting of the Radiation Research Society; Los Angeles, CA, USA (5 May 1985).

The energy deposited by the Auger electrons emitted in / sup 125/I decay may cause lethal effects in the cell. The upper limit for the dose to the CHO cell nucleus (D-bar/sub N/), based on the most recent ICRP tables, and assuming a point source distribution at the center of the nucleus is given by D-bar/sub N/ = Σ/ sup f/i/sup E/i/V/sub i/ + Σ/sup f/j/sup E/j/V/sub j/ . /sup r/ N/R/sub j/, for R/sub i/ < r/sub N/, R/sub j/ > r/sub N/, where f/sub i/ or /sub j/ is the frequency per decay of emission of an Auger electron i or j, E/sub i/ or /sub j/ is the energy of that Auger electron, and V/sub i/ or /sub j/ is a spherical volume (radius = range R/sub i/ or /sub j/), and r/sub N/ = 4.63 μm is the radius of the CHO cell nucleus. The dose to the nucleus is 7.19 MeV/μm/sup 3/ . decay. The M-XY Auger electron, with a range in unit density material of 41 nm, contributes 7.17 MeV/μm/sup 3/ . decay or 99.8% of the total dose to the nucleus. A computer graphics program was developed to show the range and density of energy deposition of each /sup 125/I Auger electron, which are correlated to cellular structures. The nucleus is believed to contain the most radiation-sensitive target, and the M-XY Auger electron contributes nearly all its dose to the nucleus, because its range is equal to the diameter of a solenoid fiber in chromatin structure.

23125 **Oncogenic transformation of mouse 3T3 cells following single and fractionated doses of high and low LET radiations.** Geard, C.R.; Georgson, M.; Travisano, M. (Radiological Research Lab., College of Physicians and Surgeons of Columbia Univ., New York, NY 10032). pp 38 of Thirty-third annual meeting of the Radiation Research Society (Abstracts). Philadelphia, PA; Radiation Research Society (1985). (CONF-8505113—).

From 33. annual scientific meeting of the Radiation Research Society; Los Angeles, CA, USA (5 May 1985).

Oncogenic transformation in vitro of rodent derived cell lines has been thoroughly documented for radiations of a range of LETs. In general single acute doses of radiation produce quantitative though plateauing increases in response, with radiations of higher LET being more effective at eliciting the response. However, varying dose-rate and/or fractionation of doses of different LETs produces a bewildering variety of responses ranging from an enhancement then reduced response with fractionation of increasing x-ray (low LET) doses, to gradually increasing responses to dose as dose-rate of fission neutrons (high LET) is lowered. In this study the authors ask whether fractionation of low LET (Cs/sup -137/ γ rays) and high LET (Am/sup 241/ α-particles) result in reduced, unaltered or enhanced changes in the frequencies of oncogenic transformations in mouse 3T3 cells. The RBE of α-versus γ-irradiation was found to be about 3 and for both, dose fractionation results in a reduced transformation incidence both for log-phase (proliferating) and plateau-phase (G/sub 1/) cells. Certainly fractionating high LET (α-particle) irradiations does not result in enhanced effects in the 3T3 cell system.

23126 **Amplification by TPA of the low level of transformation induced by /sup 60/CO γ-ray at 10 rad/day.** Hill, C.K.; Han, A.; Elkind, M.M. (Argonne National Lab., Argonne, IL 60439). pp 39 of Thirty-third annual meeting of the Radiation Research Society (Abstracts). Philadelphia, PA; Radiation Research Society (1985). (CONF-8505113—). Contract W-31-109-ENG-38.

From 33. annual scientific meeting of the Radiation Research Society; Los Angeles, CA, USA (5 May 1985).

The authors studied transformation in mouse embryo C3H 10T1/2 cells continuously irradiated at 10 rad/day. At cumulative total doses of 50, 150, 300, and 450 rad, they assayed aliquots of the cells for survival and neoplastic transformation with or without 0.1 μg/ml of TPA added 24 hr after irradiation. Preliminary results suggest that at 10 rad/day the induction of neoplastic transformation is reduced to a low level, which is, however, still significantly above background; the addition of TPA significantly increases the frequency. However, the data suggest that TPA does not increase the frequency to the level expected from the same dose of irradiation given as a single acute does rate exposure followed by TPA. These results imply that during a very prolonged irradiation, in addition to early repair, a slow repair process occurs that depends on dose rate. However, the fact that TPA can still amplify transformation suggests that some subeffective damage persists in the cells even after prolonged irradiations.

23127 **Genotoxicity of chronic, low doses of low or high LET radiation in human cells.** Strniste, G.F.; Chen, D.J. (Genetics Group, Los Alamos National Lab., Los Alamos, NM 87545). pp 39 of Thirty-third annual meeting of the Radiation Research Society (Abstracts). Philadelphia, PA; Radiation Research Society (1985). (CONF-8505113—).

From 33. annual scientific meeting of the Radiation Research Society; Los Angeles, CA, USA (5 May 1985).

Arrested, confluent human diploid cell populations have been used to study the effects of acute vs. protracted exposures of either X-rays (from a 250 kVp source) or 5.1 MeV α-particles (from the decay of /sup 239/Pu) on cell killing and induction of cell mutagenesis (measured at the hypoxanthine-guanine phosphoribosyl transferase (hgprt) locus). Arrested cell cultures were maintained by reducing serum concentration in the incubation medium from 10% to 0.5% at the time the plated cells reached confluency. Acute doses of X-rays or α-particles were delivered to the cells at dose rates of 0.6 or 0.2 Gy/min, respectively, whereas dose protraction of either radiation was achieved by a multifractionated scheme (5X per week for a total of 4 weeks). Multiparameter flow cytometric analysis was used to verify the stability of cells (90-95% arrested in G/sub 1/) throughout the 28-day experiment. Dose protraction of X-rays (at 0.6 Gy/min) results in significant reduction (≧3-fold at 3 Gy total dose) in cell killing and induced mutations. However, only a marginal decrease in cell killing and no change in the induced hgprt/sup -/ mutation frequency was observed for dose protraction of α-particles (at 0.2 Gy/min). These data are supportive of the idea of fundamental differences in the repair and/or expression of DNA damage in cells exposed to chronic vs. acute doses of low vs. high LET radiation.

23128 **In vitro cellular transformation induced by charged particles of defined LET.** Hei, T.K.; Hall, E.J.; Komatsu, K.; Goldhagen, P. (Radiological Research Lab., Columbia Univ., New York, NY 10032). pp 39 of Thirty-third annual meeting of the Radiation Research Society (Abstracts). Philadelphia, PA; Radiation Research Society (1985). (CONF-8505113—).

From 33. annual scientific meeting of the Radiation Research Society; Los Angeles, CA, USA (5 May 1985).

Cytotoxicity and neoplastic transformation were scored in the C/sub 3/H 10T1/2 cell system following irradiation with protons, deuterons and helium-3 ions of defined LET in the track segment mode. The charged particles were accelerated at the Radiological Research Accelerator Facility at the Nevis Laboratories of Columbia University and provided a range of LET values from 10

to 175 keV/μm. Exponential phase cultures of C3H 10T1/2 cells, growing on a thin mylar surface were irradiated with charged particles of various LET values and subsequently replated onto commercial plastic petri dishes. The cultures were incubated for six weeks at which time they were fixed, stained and type II and III scored as transformants. Over the range of LET values studied thus far, it was found that as the LET of the charged particles increased, the shoulder of the survival curves decreased and approached an exponential function of dose at LET values of 100 keV/μm and above. The transformation incidence, likewise, showed a direct correlation with LET over the dose ranges examined.

23129 **Direct and indirect mechanisms for the induction of apparent DNA-protein crosslinks by far- and near-ultraviolet radiations in human cells in culture.** Peak, M.J.; Peak, J.G.; Jones, C.A. (Div. of Biological and Medical Research, Argonne National Lab., Argonne, IL 60439). pp 37 of Thirty-third annual meeting of the Radiation Research Society (Abstracts). Philadelphia, PA; Radiation Research Society (1985). (CONF-8505113—). Contract W-31-109-ENG-38.

From 33. annual scientific meeting of the Radiation Research Society; Los Angeles, CA, USA (5 May 1985).

DNA from human epithelioid P/sub 3/ cells in culture was studied by alkaline elution techniques after the cells were irradiated by monochromatic 254, 290, 313, 334, 365, 405, 434, and 545 nm ultraviolet light. An action spectrum (aerobic irradiation) for the relative efficiency of induction of apparent DNA-protein covalent bonds (crosslinks) showed a maximum at about 254 nm, with a secondary peak of activity at 405 nm. No changes in the crosslink production by 290 nm radiation were observed when the cells were irradiated under anoxic conditions or in an environment of D/sub 2/O. Under anoxic conditions, the induction of crosslinks was reduced by 80% at 405 nm, and, in the presence of D/sub 2/O, it was doubled. These findings constitute evidence that far- and near-UV radiations induce crosslinks by direct (absorption of photons directly by DNA) and indirect (photosensitizations involving nonDNA cellular sensitizers and reactive species of oxygen) mechanisms respectively.

5602 Thermal Effects

23130 (GSF—10/87, pp 227-254) **Frost events in past years as possible stress factors.** Mayer, H. (Muenchen Univ., Germany, F.R. Lehrstuhl fuer Bioklimatologie und Angewandte Meteorologie). Mar 1987. (In German). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88752006/JAW. (CONF-8610391—).

From Symposium on climate and weather as related to the novel forest disease; Neuherberg, F.R. Germany (13 Oct 1986).

Frost events in past years in Bavaria are analysed under consideration of possible frost damages in forests. The abrupt decrease of air temperature at turn of the year 1978 and extreme cold in January and February 1985 are discussed as examples for extreme cold periods in winter. Late frost in Bavaria in the period 1953 to 1986 is analysed by use of frequency distribution of days with late frost and its intensity. Late frost events in April and May 1981 are discussed as example for a single late frost period. Using the same method early frost in Bavaria in the period 1953 to 1985 is investigated. As case study early frost in September and October 1972 is analysed.

23131 (GSF—10/87, pp 265-268) **Connection between damage in spruces and pines and dramatic falls of temperature in areas of high pollution.** Materna, J. Mar 1987. (In German). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88752006/JAW. (CONF-8610391—).

From Symposium on climate and weather as related to the novel forest disease; Neuherberg, F.R. Germany (13 Oct 1986).

Deep temperatures in winter generally have a disadvantageous influence on the health of forests in areas of high pollution. But what can be particularly dangeroaus are the swift changes of temperature during winter. Given the general debility of forests in central Europe, a further extreme, comparable to the dramatic fall in temperature by 25-30 degrees to -22/sup 0/C on December 31, 1978, would have disastrous consequences. However, what these would be like is beyond forecast.

5603 Chemicals Metabolism And Toxicology

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23132 (BNL—40629-Vol.3) **Kosova coal gasification plant health effects study: Volume 3, Retrospective epidemiology.** Morris, S.C.; Haxhiu, M.A.; Canhasi, B.; Begraca, M.; Ukmata, H. (Brookhaven National Lab., Upton, NY (USA); Kosova Univ., Pristina (Yugoslavia). Medical Faculty; Electropriveda Kosova, Pristina (Yugoslavia). Medical Dept.). Dec 1987. Contract AC02-76CH00016. 161p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE88005613/JAW.

Disease incidence in coal gasification plant workers in Kosova, Yugoslavia, was compared to that in lignite surface miners who received medical care in the same clinic. No statistically significant difference in incidence rate was found for any of twelve disease categories examined. Early development of a high skin cancer rate, as reported within five years of first exposure at a coal hydrogenation plant in Institute, West Virginia, did not occur. Exploratory analysis indicated trends among gasification plant workers in disease incidence with increasing years of service and increasing occupational exposure levels for chronic bronchitis and mental diseases. Particulate exposures in workers' homes were of the same order as exposures at the gasification plant and further study of residential air pollution levels is recommended. 21 refs., 2 figs., 80 tabs.

23133 (DOE/ER/60493—1-Vol.2, pp 13-17) **Nicotine uptake by nonsmokers exposed to passive smoking under controlled conditions and the elimination of cotinine.** Hoffmann, D.; Brunnemann, K.D.; Haley, N.J.; Sepkovic, D.W.; Adams, J.D. (American Health Foundation, Valhalla, NY). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Six nonsmokers were exposed to environmental tobacco smoke in a small room twice daily for 80 minutes each. Urine and saliva were collected before the morning exposure and after the exposure in the afternoon; exposure and sampling were continued for five days. Nicotine in the urine reached up to 160 ng/mg creatinine and in saliva up to 1100 ng/ml. Cotinine was found in urine up to 100 ng/mg creatinine and in saliva up to 17 ng/ml. Two days after the last exposure, nicotine was still present in urine (35 ng/mg creatinine), whereas cotinine was found in both urine (46 ng/mg creatinine) and saliva (5 ng/ml). In order to assess the elimination of nicotine and cotinine, their urinary levels were measured during three days of ETS exposure and eight days after the exposure. The levels of nicotine and cotinine were steadily decreasing with time although some residual amounts could still be detected eight days after the last exposure.

23134 (DOE/ER/60493—1-Vol.2, pp 18-21) **Serum and urine cotinine as quantitative measures of passive tobacco smoke exposure in young children.** Henderson, F.W.; Morris, R.; Reid, H.F.; Hu, P.C.; Mumford, J.L.; Forehand, L.; Burton, R.; Lewtas, J.; Hammond, S.K.; Haley, N.J. (Univ. of North Carolina, Chapel Hill). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The relationship between passive home tobacco smoke exposure and levels of cotinine in serum and urine was studied in a population of children who attended a day care center. Parents saved the remains of all cigarettes smoked in their homes over the five days prior to procurement of serum and urine samples for cotinine

determinations. Active home air monitoring for nicotine was performed on the two days prior to collection of serum and urine specimens. Urine cotinine was a more sensitive marker of exposure than serum cotinine. Among exposed children, levels of urine and serum cotinine were both correlated significantly with intensity of ETS exposure manifested by number of cigarette butts collected and by levels of nicotine recovered from air samples. Urine cotinine is a useful supplemental measure of exposure in epidemiologic studies of the health effects of ETS.

23135 (DOE/ER/60493—1-Vol.2, pp 22-28) **Respiratory effects of early childhood exposure to passive smoke.** Stern, B.; Raizenne, M.; Burnett, R.; Kearney, J. (Dept. of National Health and Welfare, Ottawa). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The effects of early exposure to maternal smoking were investigated in a cohort of over 4000 Canadian school children. Standard respiratory questionnaires were completed by parents; spirometry was performed in the school. An increased incidence of hospitalization before age 2 for a chest illness was associated with maternal smoking during pregnancy and during the child's first two years. Cough and asthma were more prevalent in children whose mothers smoked during pregnancy; cough, phlegm and asthma were more frequent in children whose mothers smoked during the child's first 2 years. Hospitalization before the age of 2 was significantly associated with an increase incidence of current respiratory symptoms and decreased pulmonary function.

23136 (DOE/ER/60493—1-Vol.2, pp 29-33) **Heart disease mortality in persons living with smokers.** Sandler, D.P.; Helsing, K.J.; Comstock, G.W. (National Institute of Environmental Health Sciences, Research Triangle Park, NC). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

A private census of Washington County, Maryland in 1963 obtained information on smoking habits of all adults in the census, and death certificates of all residents who died in the next 12 years were matched to the census. Among the white population 3456 men and 12,344 women had never smoked. In this group, death rates from arteriosclerotic heart disease (ASHD) were significantly higher among men (Relative Risk = 1.31) and women (RR = 1.24) exposed to smoke from others in the household, after adjusting for age, marital status, years of schooling and quality of housing. The trend with increasing exposure level was significant ($p < 0.001$) for women but not for men.

23137 (DOE/ER/60493—1-Vol.2, pp 34-38) **Environmental tobacco smoke and lung cancer in Swedish women.** Pershagen, G.; Svensson, C.; Hrubec, Z. (National Institute of Environmental Medicine, Stockholm, Sweden). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The risk of lung cancer in women married to smokers was investigated in a case-control study nested in a cohort of 27,409 female nonsmokers. Questionnaires provided information on smoking by study subjects and their spouses as well as on potential confounding factors. There was an increased risk of pulmonary carcinomas of the squamous and small cell types in women, who had been married to smokers and indications of positive dose-response relationships. No consistent effects were seen for other histological types, suggesting that exposure to environmental tobacco smoke is related primarily to those forms of lung cancer which show the highest relative risks in smokers.

23138 (DOE/ER/60493—1-Vol.2, pp 52-56) **Sensory irritation from exposure to environmental tobacco smoke.** Clausen, G.H.; Nielsen, K.S.; Sahin, F.; Fanger, P.O. (Technical Univ. of Denmark, Lungby). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Forty one occupants evaluated the air quality in an environmental chamber during exposure to eight concentrations of tobacco smoke, with corresponding increments of carbon monoxide ranging from 0 to 10 ppm. The evaluations comprised assessments of odor intensity, acceptability and irritation of eyes, nose and throat. Eye blinking rate of the subjects was recorded on video and later counted. A total of 50 two-hour tests were performed with eight subjects participating in each. After approximately one hour of exposure all subjective assessments had reached steady-state levels. They increased with smoke concentration. Particle filtration of the smoke showed no significant impact on the irritation of eyes, nose and throat. A ventilation rate of 12 m^3/cigarette was found to keep irritation of eyes, nose and throat at an acceptable level.

23139 (DOE/ER/60493—1-Vol.2, pp 57-60) **Inhaled amount of tobacco smoke during passive smoking.** Curvall, M.; Kazemi-Vala, E.; Enzell, C.R.; Olander, L.; Johansson, J. (Swedish Tobacco Co., Stockholm). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Six nonsmokers were exposed to three different levels of sidestream smoke in a closed room of 100 m^3 during 1, 2, or 4 hours. The concentrations of particles, carbon monoxide and nicotine were measured continuously during the exposure. The concentrations of nicotine and cotinine in plasma, saliva and urine and of COHb in blood were measured before and after the exposure. The results indicate that urinary nicotine and cotinine are reliable makers for long term environmental tobacco smoke (ETS) exposure, while plasma and salivary cotinine are good indicators of short as well as long term exposure.

23140 (DOE/ER/60493—1-Vol.2, pp 61-67) **Elimination of urinary cotinine in children exposed to known levels of side-stream cigarette smoke.** Goldstein, G.M.; Collier, A.; Etzel, R.; Lewtas, J.; Haley, N. (Environmental Protection Agency, Research Triangle Park, NC). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The establishment of a quantitative personal marker of sidestream smoke exposure in children is important in the study of potential health effects in this group. Cotinine, a metabolite of nicotine, has been shown to exhibit a dose-response relationship to sidestream smoke exposure in adults, and has been used to quantitate prior exposure. This study was undertaken to determine the dose of nicotine, the peak level of urinary cotinine, the time to peak cotinine levels, and the elimination half-life of cotinine in young children exposed to a controlled amount of side-stream smoke. With an exposure of 26.4 $\mu g/m^3$ of nicotine, nine children, averaging 2.03 years old had peak cotinine/creatinine levels of 818 ng/mg. The time to peak cotinine was 4.1 hours, with an elimination half-life of 28.7 hours.

23141 (DOE/ER/60493—1-Vol.2, pp 68-73) **Sidestream smoke uptake by Syrian golden hamsters in an inhalation bioassay.** Haley, N.J.; Adams, J.D.; Axelrad, C.M.; Hoffmann, D. (American Health Foundation, Valhalla, NY). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

An inhalation bioassay with Syrian golden hamsters is being conducted to evaluate the toxic and carcinogenic potential of sidestream smoke (SS) relative to mainstream smoke (MS) of the same cigarette. This long-term bioassay utilizes dilutions of smoke which do not cause acute toxicity in the animal. In each exposure, the SS instrument delivers 37 mg of tar and 1.8 mg nicotine to each animal while MS nose only delivery provides 16 mg tar and 1.1 mg nicotine. Monthly measurements of carboxyhemoglobin (COHb), nicotine and cotinine have shown that SS and MS exposed animals are absorbing tobacco smoke constituents. Survival data collected after 18 months of the bioassay indicate a higher mortality for SS exposed animals relative to MS exposed hamsters.

23142 (DOE/ER/60493—1-Vol.2, pp 74-79) **Urinary excretion of hydroxy-phenanthrenes after intake of polycyclic aromatic hydrocarbons.** Hoepfner, I.; Scherer, G.; Adlkofer, F.; Dettbarn, G.; Grimmer, G. (Forschungsgesellschaft Rauchen und Gesundheit mbH, Hamburg, Germany, F.R.). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

A diet rich in polycyclic aromatic hydrocarbons (PAH) leads to a rise in urinary hydroxy-phenanthrene (OH-PHE) excretion as compared to a diet low in PAH, coming close to significance. Urinary OH-PHE excretion in non-smokers exposed to environmental tobacco smoke (FTS) is not increased nor was there any significant difference in OH-PHE excretion between smokers (S) and non-smokers (NS). Preliminary data suggest that OH-PHE excretion in workers occupationally exposed to high concentrations of PAH in ambient air is clearly elevated.

23143 (DOE/ER/60493—1-Vol.2, pp 80-84) **Intake of nicotine from environmental tobacco smoke (ETS) via different inhalation routes.** Jarczyk, L.; Scherer, G.; Hoepfner, I.; Luu, H.T.; Adlkofer, F. 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

An initial experiment was performed on the intake of nicotine with regard to the mode of inhalation. Preliminary data suggest that nicotine intake is higher when ETS is inhaled through both mouth and nose or the mouth only than through the nose only. The data obtained so far are in line with the assumption that, apart from broncho-alveolar intake, considerable nicotine absorption takes place via the oral and nasal mucosa. This finding has still to be confirmed by further investigation.

23144 (DOE/ER/60493—1-Vol.2, pp 85-90) **Urinary cotinine measurements for passive smokers using gas chromatography and flame thermionic detector with glass capillary column.** Matsuki, H.; Yanagisawa, Y.; Spengler, J.; Kasuga, H. (Harvard School of Public Health, Boston, MA). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

An improved method has been devised for determining urinary cotinine concentration using gas chromatography with a glass capillary column and flame thermionic detector. Simple solvent extraction procedures with an Extrelut column permit a large number of samples to be analyzed. This method could be applied for urinary excretion rate measurements of both active and passive smokers in large epidemiological surveys.

23145 (DOE/ER/60493—1-Vol.2, pp 91-96) **Measurement of personal exposure to mutagens in environmental tobacco smoke.** McCurdy, S.A.; Kado, N.Y.; Schenker, M.B.; Hammond, S.K.; Benowitz, N.L. (Univ. of California, Davis). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Nonsmoking volunteers were exposed to environmental tobacco smoke (ETS) in a gambling casino or in a bingo hall to study the feasibility of measuring personal exposure to airborne mutagens as an index of ETS exposure. Using a sensitive Salmonella micro pre-incubation assay, ambient concentrations of mutagenic activity detected on personal sampling filters ranged from 552 to 3628 revertants/m^3 (median=1565 revertants/m^3). Suspended particle concentrations ranged from 172 to 525 $\mu g/m^3$ (median-295 $\mu g/m^3$). Ambient nicotine concentrations ranged from 3.3 to 85 $\mu g/m^3$ (median=36 $\mu g/m^3$). Based on measurements per filter, Spearman correlation coefficients for mutagenic activity with nicotine mass and total particle mass were 0.96 ($p < 0.001$) and 0.82 ($p < 0.005$), respectively. No significant correlations were detected between measures of ambient exposure and urinary nicotine or cotinine levels corrected for urine creatinine.

23146 (DOE/ER/60493—1-Vol.2, pp 97-103) **Urinary hydroxyproline excretion in young males exposed experimentally to nitrogen dioxide.** Muelenaer, P.; Reid, H.; Morris, R.; Saltzman, L.; Horstman, D.; Collier, A.; Henderson, F. (Univ. of North Carolina, Chapel Hill). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Acute exposure to high levels of nitrogen dioxide (NO_2) is associated with lung injury in experimental animals and man. The pulmonary consequences of repeated or prolonged low level NO_2 exposure, as experienced by persons utilizing gas stoves for cooking or non-vented kerosene space heaters, are unknown. Fourteen healthy, young adult males were studied in a double blind prospective experiment to determine whether differences in urinary hydroxyproline excretion were associated with experimental exposure to 0.6 ppm NO_2 for four hours a day on three consecutive days. Changes in the urinary hydroxyproline:creatinine ratio were monitored in relation to exposure to both NO_2 and air in all subjects. No evidence of increased hydroxyproline excretion related to NO_2 exposure was found ($p = 0.92$).

23147 (DOE/ER/60493—1-Vol.2, pp 104-108) **Enhanced transformation of Syrian hamster embryo cells by combined exposure to cigarette smoke extract and benzo(a)pyrene or nickel sulfate.** Sanner, T.; Rivedal, E. (Norwegian Radium Hospital, Oslo). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The in vitro morphological transformation of primary Syrian hamster embryo (SHE) cells by cigarette smoke extract and the interaction with benzo(a)pyrene and nickel sulfate have been studied. The results showed that cigarette smoke extract induced morphological transformation of SHE colonies. Benzo(a)pyrene and nickel sulfate enhanced the transformation frequency in a synergistic manner when present together with cigarette smoke extract. Experiments involving sequential exposure of the cells to benzo(a)pyrene and smoke extract indicate that cigarette smoke extract acts primarily as a promoter in the transformation of SHE cells.

23148 (DOE/ER/60493—1-Vol.2, pp 109-114) **Biomonitoring of exposure to potentially mutagenic substances from environmental tobacco smoke (ETS).** Scherer, G.; Westphal, K.; Hoepfner, I.; Adlkofer, F.; Sorsa, M. (Forschungsgesellschaft Rauchen und Gesundheit mbH, Hamburg, Germany, F.R.). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

In two studies 10 non-smokers were put on a strictly controlled diet and exposed to two different ETS concentrations for 8 h. Average indoor air levels of CO, NO and NO_2 were 10 ppm, 160 ppb and 20 ppb, respectively, during the exposure period in study 1. During study 2 the respective concentrations were 21 ppm, 310

ppb and 150 ppb. Carboxyhemoglobin increased by 0.7% after exposure in study 1 and by 2.0% in study 2. Urinary mutagenicity was slightly but not significantly elevated after ETS exposure, while it was significantly increased in 10 smokers after smoking. The relative increase in thioether excretion was up to 45% after ETS exposure and was found to rise only slightly after smoking (50-65%). The authors suggest that the cellular glutathione system is capable of detoxifying the amount of potentially mutagenic substances taken in during real-life ETS exposure.

23149 (DOE/ER/60493—1-Vol.2, pp 115-118) **Evaluation of tobacco smoke using urinary cotinine as an indicator of dose and hydroxyproline as an indicator of effects.** Yanagisawa, Y.; Matsuki, H.; Spengler, J.D.; Kasuga, H. (Harvard School of Public Health, Boston, MA). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Daily excretion of urinary cotinine, hydroxyproline and creatinine were measured for 14 consecutive days to evaluate the effects of cessation of smoking. Two active smokers were chosen as subjects and they stopped smoking on the 6th day of the study. The excretion of urinary cotinine dropped rapidly after quitting smoking and approaches the value of non-smoker's within 5 days. Urinary excretion of other constituents did not change so quickly.

23150 (DOE/ER/60493—1-Vol.2, pp 121-125) **Reliability and validity of questionnaire assessment of involuntary tobacco smoke exposure.** Coultas, D.V.; Samet, J.M.; Peake, G.T.; McCarthy, J.; Spengler, J. (Univ. of New Mexico School of Medicine, Albuquerque). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

In epidemiological studies of involuntary smoking and health, questionnaires have most often been used to measure exposure to environmental tobacco smoke. However, further characterization of the accuracy of the questionnaires on exposure to environmental tobacco smoke is needed. The authors have conducted investigations to determine the reliability and validity of questionnaires on lifetime and current exposure to environmental tobacco smoke. The concordance of responses on the smoking habits of parents, spouses and other household members was high when subjects were interviewed within six months. However, information on quantitative exposure variables, including amount, years, and hours smoked by household smokers, was less reliable. In 10 homes monitored repeatedly for nicotine and respirable particulate mass, the usual number of cigarettes smoked in the house did not strongly predict levels of these markers.

23151 (DOE/ER/60493—1-Vol.2, pp 147-151) **Perception of daily cigarette consumption.** Moschandreas, D.J.; Sterling, D.A.; Gibbons, R.D. (IIT Research Institute, Chicago, IL). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Information obtained by means of a self-report comfort and environment questionnaire from 163 respondents in 49 office work areas shows that nonsmokers perceived the number of cigarettes smoked within their office work areas as significantly lower than either the number perceived or reported consumed by smokers. There were no significant differences, however, between the perceptions reported by smokers of cigarette consumption and of reported consumption. Repeated application of the same questionnaire, or sensitization, had no effect on either the smokers or nonsmokers and their perceived frequency of smoking.

23152 (DOE/ER/60493—1-Vol.2, pp 152-155) **Indoor air pollution through smoking - a challenge to industrial medicine.** Reckendorf, H. 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Evidence has accumulated in recent years, showing that non-smokers have higher levels of nicotine, carbon monoxide and other toxic substances in their blood when exposed to tobacco smoke. The concentration of nitrosamines is up to 50% higher in the side stream smoke that in the main stream smoke. The company physician plays a key role in controlling and reducing indoor air pollution caused by tobacco smoke. The author can and should inform smokers about health hazards, and he must protect nonsmokers from involuntary inhalation of tobacco smoke.

23153 (DOE/ER/60493—1-Vol.2, pp 161-165) **Strategies to avoid negative health effects of passive smoking.** Schlatter, J.; Wanner, H.U. (Federal Institute of Technology, Zuerich, Switzerland). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Tobacco smoke, one of the most frequent pollutants in indoor air is a mixture that cannot easily be characterized and quantified. In addition, the criteria of the desired air quality must first be defined: if these are avoidance of any annoyance and any health risk at all even for the most sensitive persons, the only strategy is to separate smokers from nonsmokers. If the criterion for a satisfactory air quality is the avoidance of acute irritating effects in healthy people, this can be met by ventilation strategies which will be discussed. In small rooms with natural ventilation and with a relatively low air infiltration rate, air cleaning devices may contribute to improved air quality.

23154 (DOE/ER/60493—1-Vol.2, pp 166-169) **Passive smoking as a scientific, political, juridical and economic problem.** Schmidt, F. (Univ. of Heidelberg, Mannheim, Germany, F.R.). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Scientists and physicians tend to consider problems of health from a scientific point of view exclusively, although it has long been known that this proverbial ivory tower of science standpoint is much too narrow. Applied to the problems of smoking and passive smoking, this is especially valid: Health risks call for countermeasures. These cost money, as a rule even vast sums of money. It would be naive therefore to ignore the economical and political as well as the legal aspects of the issue. Ever since the expense for health care began sky rocketing we know that these aspects must be taken into account especially for smoking and passive smoking too. No Minister of Finance regardless of nationality would want to be deprived of the revenues from tobacco tax. Without a doubt, this is an essential reason for the lack of support and the halfhearted measures which governments assume against smoking. In addition, the cigarette industry is finally very strong: Money is power. Experience has shown that cigarette companies spare no endeavors in using their financial possibilities to boost their turnover. But the tide is against them.

23155 (DOE/ER/60493—1-Vol.2, pp 175-180) **Maternal smoking and pulmonary performance in children: a critical analysis.** Witorsch, R.; Witorsch, P. (Medical College of Virginia, Richmond). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Thirteen of 18 epidemiologic reports reviewed herein have claimed that parental (usually maternal) smoking decreased pulmonary function in children. These reports exhibit significant discrepancies in the absolute and dose-related effects of parental smoking on the most prevalently used spirometric parameters (FEV and FEF/sub 25-75/) in children. These inconsistencies may reflect errors in estimating ETS exposure from questionnaire data, and/or inadequate attention to socioeconomic factors and other confound-

ing variables. Furthermore, alternate explanations for apparent ETS effects, such as genetic aggregation of pulmonary function and maternal smoking during pregnancy and lactation have not been excluded. Additional studies, appropriately controlled, are necessary to answer the question of whether ETS impairs pulmonary function in children.

23156 (DOE/ER/60493—1-Vol.2, pp 183-187) **Experimental animal study for risk assessment of indoor air pollutants.** Glaser, U.; Hochrainer, D.; Mueller, J.; Otto, F. (Fraunhofer Institute for Environmental Chemistry and Ecotoxicology, Schmallenberg, Germany, F.R.). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Rats were exposed to volatile components in concentrations typical for indoor air pollutant mixtures in the following atmospheres for a one month inhalation study: (1) continuous basic exposure to the inorg gases NO_2 (0, 1 ppm), CO (20 ppm) and CO_2 (0, 2%) together with respirable particles (0, 2 $\mu g/m^3$), (2) exposure to 20 volatile hydrocarbons (< 1/10 MAK for each chemical), (3) exposure to vapors (20 mg/m^3) produced by frying fish and fat twice a day. After exposure several significant effects were found in comparison to the controls breathing filtered fresh air, e.g., hematological changes due to carbon monoxide or clinico-chemical effects due to the hepatotoxicity of the volatile hydrocarbon mixtures. Most significant were effects on lung cell DNA observed in flow cytometric measurements. Indications for genotoxicity were found in all exposure groups.

23157 (DOE/ER/60493—1-Vol.2, pp 188-192) **Indoor air quality and respiratory diseases in children.** Englert, N.; Prescher, K.E.; Seifert, B. (Institute for Water, Soil and Air Hygiene, Berlin, Germany, F.R.). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

In a study on air quality and respiratory diseases, 40 children were observed in winter 1984/1985. NO_2 and SO_2 concentrations were measured using passive samplers located in the children's rooms and worn by the children; additional ones for NO_2 were used outdoors. Indoor humidity and temperature were monitored. Average NO_2 concentrations (48 to 72 hours) were clearly lower indoor than outdoors. The close agreement observed between personal and indoor NO_2 values suggests that indoor measurements provide a good estimate for the exposure of young children. The use of actually available passive samplers cannot provide us with a sufficiently detailed exposure pattern for a sufficient number of individuals to evaluate health effects. As an alternative we suggest exact continuous measurements in a couple of homes in order to obtain data for establishing model calculations.

23158 (DOE/ER/60493—1-Vol.2, pp 193-197) **Health effect oriented multipollutant human exposure study.** Sega, K.; Fugas, M. (Institute for Medical Research and Occupational Health, Zagreb, Yugoslavia). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The design and preliminary results of an ongoing human exposure study are presented. The aim of the study is to assess realistic exposure of Zagreb inhabitants to respiratory irritants. The investigation includes: identification of basic characteristics of the Zagreb population from the census data; administration of a questionnaire to members of households randomly selected from a population sample stratified at the local community level; measurement of respirable particle, NO_2, SO_2 NH_3, phenol and HCHO concentrations in the microenvironment indicated by completed questionnaires and weekly diaries on subjects' whereabouts, development of exposure models and verification of calculated values by personal exposure monitoring.

23159 (DOE/ER/60493—1-Vol.2, pp 198-202) **Epidemiological study of respiratory responses to indoor/outdoor air quality.** Quackenboss, J.J.; Lebowitz, M.D.; Hayes, C. (Univ. of Arizona, Tucson). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Exposures to outdoor-type pollutants have been linked to indoor sources; exposures to indoor-specific pollutants also occur. The recognition of indoor air quality as a major component of total human exposure to air pollutants has raised serious questions about the adequacy of exposure assessment in previous air pollution-health effects studies. Not only do outdoor pollutants penetrate indoors in the work place or school and in the home, but these locations may also contain sources of air pollutants (i.e., nitrogen dioxide, suspended particulate matter, formaldehyde). Thus, a study has been designed to evaluate respiratory responses to these pollutant exposures from their various sources. Evaluation of interactions of pollutants as they affect health is designed to be major component of this study.

23160 (DOE/ER/60493—1-Vol.2, pp 203-207) **Associations of health status with indicators of indoor air pollution from an epidemiologic study in six US cities.** Dockery, D.W.; Spengler, J.D.; Speizer, F.E.; Ferris, B.G. Jr.; Ware, J.H.; Brunekreef, B. (Harvard School of Public Health, Boston, MA). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

New samples of approximately 6000 preadolescent children in six US cities were examined with a revised questionnaire which allowed better definition of exposures to passive smoking and gas stoves plus use of wood stoves and unvented kerosene heaters. Respiratory symptom frequencies increased with the number of cigarettes smoked in the home, and no association was found with non-respiratory illnesses. The prevalence of respiratory illnesses was also higher in homes with wood stoves. No significant associations were found with use of gas stoves or kerosene heaters.

23161 (DOE/ER/60493—1-Vol.2, pp 227-231) **Health risk profile for indoor air.** Ammann, H.M.; Berry, M.A. (Environmental Protection Agency, Research Triangle Park, NC). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Consideration of health risk from air pollutants has in the past often focused on mortality data, especially from cancer, with occasional expansion to serious debilitating illness. Since people spend 80% or more of their time indoors, exposure to pollutants found in indoor spaces comprise an important part of total exposure to pollutants. Indoor exposure could represent an important fraction of the total exposure causing increases in mortality. Other effects not related to life span caused by exposure to indoor pollutants could have significant impact on health and well-being. Such effects can range from mortality, serious debilitating illness, episodic serious illness, chronic episodes of malaise that reduce normal function and productivity, to general malaise that reduces well-being. It is useful to construct a continuation of health parameters affected by various indoor pollutants and to correlate such health parameters with specific pollutants or sources found indoors. The relative ranking of health effects by seriousness of effect is obviously subject to debate, whether neurotoxic or hepatotoxic effects are more or less serious than chronic lung effects is largely a matter of degree of effects, and can be influenced by considerations such as health care cost or effect on productivity. This specific attempt to establish a health effects ranking is not intended to be absolute, but is meant as an attempt to establish a profile of effects that will broaden the perspective of health considerations associated with indoor air pollutants.

23162 (DOE/ER/60493—1-Vol.2, pp 247-251) **Environment and health survey and analyses of environmental exposure factors in the Federal Republic of Germany.** Krause, C.; Kirschner, W.; Schulz, C.; Dube, P. (Institute for Water, Soil and Air Hygiene, Berlin, Germany, F.R.). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

This report describes the first representative investigation conducted in the Federal Republic of Germany to evaluate the actual internal (intracorporeal) and external (environmental) exposure of the population. Emphasis was placed on the indoor environment. To understand the subjectively felt exposure of German citizens and their behavior and attitude towards the expected to provide a basic data pool for a variety of substances, potentially dangerous to human health, to ascertain norm values, understand the trend and finally to establish a basis for necessary preventive measures to be taken on a regional or national level.

23163 (DOE/ER/60493—1-Vol.2, pp 459-463) **Monitoring of symptoms as a control of the effect of intervention in the sick building syndrome.** Hansen, L. 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Employees in seven different buildings were asked to fill in a simple questionnaire at the time where a sick building syndrome was diagnosed in the buildings. After changes and alterations in the buildings were carried out the employees were asked about indoor climate symptoms after a one year period of observation. Reduction of symptom frequency was observed in some buildings, however in other buildings no positive effects were observed at all. Consequently, proposed changes in buildings are not always relevant. This result indicates that systematic monitoring of employees symptoms before and after introducing building changes should be routinely carried out when tackling indoor climate problems.

23164 (DOE/ER/60493—1-Vol.2, pp 464-468) **Office worker perceptions of indoor air quality effects on discomfort and performance.** Woods, J.E.; Drewry, G.M.; Morey, P.R. (Honeywell Indoor Air Quality Diagnostics, Minneapolis, MN). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

To address office worker perceptions of indoor air quality effects on their comfort and well-being, a stratified random sample of 600 US office workers was surveyed by telephone. Temperature and lighting were cited as the most important factors, followed by housekeeping, air quality and noise. A significant percentage of respondents (24%) indicated that they were dissatisfied with the air quality at the office. Moreover, 20% of the 600 perceived their performance to be hampered by the air quality. The symptoms they described are similar to those identified with Sick Building Syndrome. Based on these data, we propose a preliminary hypothesis: it is possible that 20% of the office workers in the US are exposed to environmental conditions that are manifested as the Sick Building Syndrome.

23165 (DOE/ER/60493—1-Vol.2, pp 469-473) **Sick buildings - a subpopulation among the problem buildings.** Moelhave, L. (Institute of Hygiene, Arhus, Denmark). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

It is suggested, that the term problem building in relation to indoor climate should be used to describe any building, in which the occupants are dissatisfied with their atmospheric indoor environment. The term the sick building, should be restricted to multifactorial problems, where no single factor exceeds the limits of generally accepted recommendations or thresholds. The sick building syndrome may be compressed into a set of criteria: (a) five general types of complaints should cover the complaints found in the building; (b) sensoric irritation must be dominating; (c) systemic symptoms e.g. from lower airways or stomach should be infrequent, (d) no single cause for the problem should be identified neither in relation to the indoor environment not to the occupants, and the complaints should occur only in certain indoor environments.

23166 (DOE/ER/60493—1-Vol.2, pp 477-481) **Do sick buildings affect human performance? how should one assess them.** Berglund, B.; Berglund, U.; Engen, T. (Univ. of Stockholm, Sweden). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

An experiment designed to study the sick building syndrome is described. Forty eight previously unexposed subjects were tested with a battery of diverse psychological tests (reaction-time, short-term memory, vigilance, steadiness) both in a sick building and in a control building. The purpose was to observe actual behavior, because present information is based on questionnaires regarding clinical symptoms. The results were negative despite a favorable research situation. Possible explanations are discussed in terms of the choice and treatment of the subjects, the nature of the performance tests, whether to perform the test in the laboratory or in the field, and the possibility that the sick building syndrome is an interaction of indoor air, the work environment, and individual characteristics.

23167 (DOE/ER/60493—1-Vol.2, pp 487-491) **Sick building syndrome further prevalence studies and investigation of possible causes.** Harrison, J.; Pickering, A.C.; Finnegan, M.J.; Austwick, P.K.C. (Wythenshawe Hospital, Manchester, England). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

A total of 2587 white collar workers in 27 buildings participated in a study of building related symptoms - collectively referred to as the sick building syndrome. Prevalences rates, obtained via a doctor-administered questionnaire, were significantly higher in buildings with sealed windows and differing ventilation systems compared to a naturally ventilated control group. There was, however, a significant variation in symptom prevalences within the control group. The results of air sampling in 2 buildings and analysis of VDU usage in 2 buildings did not correlate with symptom prevalences in the buildings.

23168 (DOE/ER/60493—1-Vol.2, pp 492-496) **Indoor climate and employee health in offices.** Hedge, A.; Wilson, S.; Burge, P.S.; Robertson, A.S.; Harris-Bass, J. (Cornell Univ., NY). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

A sample of 4373 office workers were surveyed in buildings ventilated by either natural, mechanical, or forced air, or by air conditioning or some form of comfort cooling including fan-coil, induction, and constant or variable air volume systems. Reports of work-related symptoms of dry eyes, dry throat, stuffy/congested nose, itching/watering eyes, runny nose, lethargy/tiredness, and headache were consistently highest in air conditioned buildings, and symptom prevalence was higher for water-based systems e.g. fan-coil or induction systems, than for all-air systems. There was a significant relationship between the type of humidification used (none, evaporative/spray, steam) and the prevalence of dry eyes, dry throat, stuffy nose, and lethargy in air conditioned buildings. Type of organization and worker's sex significantly affected symptom reports.

23169 (DOE/ER/60493—1-Vol.2, pp 515-519) **Overfrequencies of skin and airway symptoms among personnel in sick buildings and polluted industrial environments in relation to exposure.** Norbaeck, D.; Rand, G.; Michel, I.; Amcoff, S. (Dept. of Occupational Medicine, Uppsala, Sweden). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Symptom frequencies were studied among personnel in sick buildings, non-exposed referent groups and workers exposed to irritants. The exposures were quantified by hygienic measurements. The overfrequencies of symptoms were more pronounced in the sick buildings than among the exposed workers, but the exposure levels were much lower in the sick buildings than in the industry. The results might indicate that indoor environments could be as potent as industrial environments in inducing irritative symptoms. An alternative explanation could be that other factors than the exposure are involved in the sick building syndrome. It can be concluded that the healthy worker effect only partly explain the observed differences.

23170 (DOE/ER/60493—1-Vol.2, pp 525-529) **Hypothesis on the mechanisms of the health effects of mechanical ventilation and warm air heating.** Sammaljaervi, E. (National Public Health Institute, Helsinki, Finland). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The natural background air contains an optimum mixing and concentration of air gas components. Well-being and health are assumed to depend e.g. on the stimulating effects of ozone, ion spectrum, and natural molecular energy excitation states of gases. Unphysiological molecular excitation states or configurations, especially of water and too low ozone concentration, are associated with mechanical ventilation and warm air (electric) heating. The hazardous health effect hypothesis of these changes is supported by epidemiological studies, clinical exposure experiments with humans, and biochemical cell metabolism and energy production (ATP) changes in ozone and ion exposure studies. The aging ventilated air molecules undergo excitation/relaxation depending on the physical characteristics of space.

23171 (DOE/ER/60493—1-Vol.2, pp 530-534) **Skin complaints in sick buildings.** Stenberg, B. (Umea Univ. Sweden). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The sick building syndrome (SBS) as defined by WHO is a combination of both common and unspecific symptoms. Few studies have been published with detailed descriptions of clinical findings. One of few dermatological references with close relation to sick buildings is the so-called low humidity occupational dermatosis. Since 1982 an increasing number of out-patients from sick buildings have been investigated at the department of dermatology in Umea. The most common findings of work related diseases have been seborrhoeic dermatitis, facial erythema, periorbital eczema, rosacea, urticaria and itching folliculitis. It is suggested that both physical, chemical and psychological factors are of importance to produce these symptoms.

23172 (DOE/ER/60493—1-Vol.2, pp 542-546) **Prevalence of symptoms of the sick building syndrome in buildings without expressed dissatisfaction.** Finnegan, M.J.; Pickering, A.C. (Brompton Hospital, London, England). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The prevalence of symptoms commonly encountered in sick buildings was assessed using a standard questionnaire in five hermetically sealed offices with varying systems for air conditioning, and the results compared with symptom prevalences in three naturally ventilated offices. Wherever possible paired air conditioned and non air conditioned offices were chosen and the subjects were interviewed without knowledge of their work site. The responsible officers in the buildings were not aware of any dissatisfaction in the buildings prior to the studies, which we initiated. There were marked statistical excesses of symptoms among the workers is the air conditioned offices, but no difference in smoking habits.

23173 (DOE/ER/60493—1-Vol.2, pp 547-551) **Negative ions and the sick building syndrome.** Finnegan, M.J.; Pickering, A.C.; Gill, F.S.; Ashton, I. (Brompton Hospital, London, England). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The effect of raising the negative ion concentration on personal and environmental comfort assessment and the frequency with which certain specific symptoms common in sick buildings were experienced was investigated in a double blind study in a sick building known to be depleted of ions of both charges. No significant improvement in comfort rating was detected and there was no decrease in symptom prevalence in the period with raised negative ions compared to the control period. The effects of temperature and relative humidity on personal and environmental comfort assessment were also assessed and gave expected results.

23174 (DOE/ER/60493—1-Vol.2, pp 552-556) **Indoor air quality investigation as a psychological stressor.** Hedge, A.; Sterling, E.M.; Collett, C.W.; Mueller, B.; Robson, R. (Cornell Univ., NY). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

In recent years, researchers and occupants have expressed concerns about possible health effects related to poor indoor air quality in modern office buildings. A case study is presented in which occupant concerns intensified into panic, which culminated in the evacuation of the building. Review of the events leading up to the evacuation suggests that the panic may have been triggered by the design and implementation of the investigation. The case study suggests that negative occupant perceptions about indoor air act as an important psychological stressor, irrespective of whether an actual problem is verified in a building.

23175 (DOE/ER/60493—1-Vol.2, pp 566-571) **Role of stress in the sick building syndrome.** Morris, L.; Hawkins, L. (Univ. of Surrey, Guildford, England). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Data are presented which indicate that symptoms of the Sick Building Syndrome do not correlate on a day-to-day basis with daily fluctuations in temperature and humidity. By comparing three buildings there is also no correlation between complaints of thermal or other environmental discomforts and ill-health complaints. However there is a significant relationship between ill-health occurrence and reported levels of stress. While we have not exhaustively measured all the possible environmental causes of Sick Building complaints, the results strongly suggest that future work should be aimed towards investigating organizational stressors as a cause of the Sick Building Syndrome.

23176 (DOE/ER/60493—1-Vol.2, pp 572-576) **Longitudinal study of symptoms associated with wall-to-wall carpets and electrostatical charge in Swedish school buildings.** Norbaeck, D.; Torgen, M. (Akademiska Sjukhuset, Uppsala, Sweden). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

A longitudinal questionnaire study was performed among personnel in two Swedish primary schools with wall-to-wall carpets and four schools with hard floor covering. The wall-to-wall carpet group reported an overfrequency of eye and airway symptoms, rashes in the face, headache, abnormal tiredness and a sensation of being electrostatically charged in comparison with personnel in schools with hard floor covering. After the removal of the wall-to-wall carpets, many of the symptom frequencies decreased to a level not significantly different from the frequencies in the group without previous or present exposure to such carpets. However, the frequency of airway symptoms remained enhanced among the wall-to-wall carpet group.

23177 (DOE/ER/60493—1-Vol.2, pp 577-581) **Observations on the sick building syndrome in a newly built large hospital.** Poellmann, L.; Poellmann, B. (Institut fuer Arbeitsphysiologie und Rehabilitationsforschung, Marburg, Germany, F.R.). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The nature of the complaints of the sick building syndrome is a kind of dissatisfaction with specified building constructions. The symptoms are headache, dizziness, exhaustion, eye irradiation, xerodermia etc. The observation confirmed that rooms were reported to be too cool in the morning relatively and too warm in the afternoon, when climate was constant. The circadian rhythms of the evaluation of climate are corresponding with the circadian changes of the thermoregulatory responses in man. The circannual rhythms show less complaints by the occupants during the summer months or respectively during the winter time with peak of complaints during spring and autumn. These courses of the circannual frequencies of complaints are in correspondence with the circannual changes of the thermoregulatory responses in man.

23178 (DOE/ER/60493—1-Vol.2, pp 589-592) **Objective signs of eye irritation in buildings suspected of causing indoor climate problems.** Franck, C.; Skov, P. (National Institute of Occupational Health, Hellerup, Denmark). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The study attempts to correlate subjective complaints of eye irritation, reported by occupants in buildings suspected of causing indoor air problems, with objective measurements performed on the external eye. A binocular microscope was used. A statistically significant association was found between eye irritation and absence of foam in the eye canthus ($p < 0.02$), decreased stability of the precorneal tear film ($p < 0.02$) and epithelial damage ($P < 0.025$). Both decreased stability of the precorneal tear film and damage of the epithelium constitute objective signs of dry eyes. A combination of these two tests in a dry eye index shows a highly significant rank correlation to eye irritation ($p < 0.00006$).

23179 (DOE/ER/60493—1-Vol.2, pp 593-597) **Influence of indoor climate on the sick building syndrome prevalence.** Valbjoern, O.; Skov, P. (Danish Building Research Institute, Hoersholm). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

In 14 town halls situated in Copenhagen and suburbs inquiry investigations of approximately 3500 employees and measurements of approximately 40 parameters which might influence the resulting indoor climate were carried out. The influence from the indoor climate parameters on work related mucous membrane irritation and general symptoms have been analyzed taking into account the influence of sex, personal characteristics, work functions and psychosocial aspects of work. In this specific material only a few of the physical parameters were beyond normally accepted limits. Analyses have shown that the total weight and the potential allergenic part of the floor dust, the area of fleecy material per m^3 of air, the length of open shelves per m^3 of air, the number of work places and the air temperature could describe the difference in the prevalence of symptoms of the employees.

23180 (DOE/ER/60493—1-Vol.2, pp 605-609) **Comparison of health of occupants of control homes and homes insulated with urea formaldehyde foam before and after corrective work.** Broder, I.; Corey, P.; Brasher, P.; Cole, P.; Lipa, M.; Mintz, S.; Nethercott, J.R. (Univ. of Toronto, Ontario). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The occupants of urea formaldehyde foam insulated (UFFI) homes showed a small excess relative to control subjects of a number of symptoms which included irritation of various body surfaces. This was accompanied by the presence of two validating objective findings, consisting of nasal epithelial squamous metaplasia, and exposure-response relationships between indoor formaldehyde levels and a number of the symptoms present in excess; most of these relationships were enhanced by UFFI. After 2/3 of the UFFI houses performed corrective work, there was an appreciable reduction in the excess of complaints, while the nasal epithelial squamous metaplasia and the exposure-response relationships both vanished. These results suggest that the adverse health effects observed in the occupants of UFFI houses were due to the UFFI-enhanced effects of formaldehyde.

23181 (DOE/ER/60493—1-Vol.2, pp 615-619) **Formaldehyde exposure and acute health effects study.** Quackenboss, J.J.; Lebowitz, M.D.; Bronnimann, D.; Michaud, J.P. (Univ. of Arizona, Tucson). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

To assess the effects of formaldehyde exposures on health, exposure groups were defined using baseline exposure and health questionnaires. Responses to questions regarding dwelling type and age, and the presence of new (less than 3 years) building materials or new furnishings were used to estimate or rank the concentrations expected in each group. This paper reports on measurements of formaldehyde concentrations made in these exposure-classified households, on efforts to verify the passive sampler measurements in a chamber using the modified NIOSH impinger-chromotropic acid method, and on results obtained from daily symptoms and peak expiratory flow measurements. The symptoms diaries include reporting of irritant symptoms such as eye irritation, sore throat, dryness in the mouth and headache; these have been used to determine the prevalence of these conditions in the exposure-classified homes. The peak expiratory flow measurements are used to classify individuals relative to their likely reactivity or sensitivity to air pollutant exposures.

23182 (DOE/ER/60493—1-Vol.2, pp 620-624) **Human reactions during controlled exposures to low concentrations of formaldehyde - performance tests.** Bach, B.; Moelhave, L.; Pedersen, O.F. (Arhus Universitet, Denmark). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Sixty-one subjects were exposed for 5 1/2 hours to a controlled atmospheric environment in a climate chamber. Formaldehyde vapors were added in concentrations 0.0; 0.15; 0.40, and 1.20 mg/m^3. The exposures were arranged in a 4 times 4 latin square design including four days on each of four weeks. The subjects were 29 randomly selected normal males and 32 males who had been working with formaldehyde for more than five years. The hypothesis was that different dose-response relations exist in a number of tests for these two groups of subjects. Several performance tests were undertaken. The results indicate such different relations for

the digit span test, the digit symbol test, the graphic continuous performance test, all testing short time memory, and for an addition test, as indications of a chronic or acute CNS effect.

23183 (DOE/ER/60493—1-Vol.2, pp 647-649) **Odor perception in smokers, non-smokers and passive smokers.** Ahlstrom, R.; Berglund, B.; Berglund, U.; Engen, T.; Lindvall, T. (Univ. of Stockholm, Sweden). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Psychophysical functions for suprathreshold concentrations of pyridine and n-butanol differ for smokers, non-smokers, and passive smokers. They are judged to be weaker by smokers than nonsmokers for all concentrations. The same is true for passive smokers, but for a different reason. Smokers are less sensitive to the odors because of a sensory deficit. Examination of response tendencies, however, show that this is not the case with passive smokers. Although they are as sensitive to the odors as non-smokers, the passive smokers appear to be habituated to tobacco smoke and thus describe them differently.

23184 (DOE/ER/60493—1-Vol.2, pp 661-665) **Functional index of human sensory irritation.** Cain, W.S. (Yale Univ., New Haven, CT). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Complaints regarding indoor air quality often include symptoms of irritation too low to verify by visual examination. In the absence of such verification, it would seem desirable to have an objective index of common chemical sense functioning. An involuntary disruption in breathing that occurs with strong nasal irritation provides an objective index. Experiments revealed that the threshold for the disruption parallels sensation almost exactly. The threshold is higher in smokers than in nonsmokers, higher in males than in females, and higher in the elderly than in the young. The threshold also shows the pattern of spatial and temporal integration found with direct estimates of perceived pungency. Its possible use to verify complaints of irritation due to poor indoor air quality awaits exploration.

23185 (DOE/ER/60493—1-Vol.2, pp 671-675) **Adaptation to odors.** Engen, T. (Brown Univ., Providence, RI). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Odors play an important role in indoor air quality. The present paper deals with the possible effect of adaptation to such odors. Such perceptual change could be desirable in case of an harmless annoying odor but dangerous in case of a toxic one. Psychophysical experiments show that while there is firm evidence for such adaptation, sensitivity is not likely to go below the threshold of detection. Instead, the effect is proportional the concentration of the adapting stimulus. However, the perceived odor intensity is virtually unaffected by duration of exposure. Finally, results in experiments with mixtures of odors show that adaptation tends to be specific to the odor exposure and show little evidence of cross-adaptation to other odors. The relevance of this to air quality is discussed.

23186 (DOE/ER/60493—1-Vol.2, pp 700-704) **Risk assessment of odor counteraction.** Raab, K.H. 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Odor modification without objective air quality improvement and a method which induces specific reversible anosmia are considered. Neurophysiological effects, problems for elderly and asthmatics as well as involvement in sick building cases are suggested. Secondary effects are substitution for ventilation or good housekeeping and interference with perception of gas odorants or environmental tobacco smoke. Regulatory controls are lacking.

23187 (DOE/ER/60493—1-Vol.2, pp 709-713) **Assessment of acute pulmonary effects of formaldehyde in an environmental chamber test facility.** Witek, T.J. Jr.; Schachter, E.N.; Tosun, T.; Leaderer, B.; Beck, G.J. (City Univ. of New York, NY). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Formaldehyde (HCHO) is a common air contaminant that is present in domestic and industrial environments. While its irritating effects are well known, characterization of acute pulmonary health effects are well known, characterization of acute pulmonary health effects have only recently been addressed. In 45 individuals divided into healthy, mild-asthmatics, and hospital laboratory workers, we evaluated acute responses to 2 ppm HCHO while at rest and with exercise in an environmental chamber test facility. Flow-volume parameters, including partial expiratory flow rates, were not compromised by HCHO exposure. Serial Peak flow measurements did not reveal delayed effects. Subjective complaints were stricted to mucus membrane irritation of the nose, eyes and throat; lower airway symptoms were not induced by HCHO. We conclude that HCHO is not an airway spasmogen under the provocative conditions of this study.

23188 (DOE/ER/60493—1-Vol.2, pp 722-726) **Relation between childhood asthma and indoor environmental elements in dwellings.** Irie, T.; Ikeda, K.; Komine, H.; Takano, A.; Sakaguchi, M.; Inoue, T.; Kawashima, Y.; Yoshikawa, M. (Institute of Public Health, Tokyo, Japan). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

A study of childhood asthma and housing environment through questionnaire and field measurements was carried out in Kawasaki in November 1985. As a result (1) indoor temperature and humidity: there was no difference between the groups of improved and not-improved. In the type of housing structure, however, average temperature was higher in multiple homes. (2) Concentrations of NO_2: there was no difference between the groups with and without asthma. As for NO_2 doses on children the not-improved group showed significantly higher values. (3) Settled dust: no difference between the groups with and without asthma. Use of futon showed an increase in the number of particles. (4) Mites on floor: no difference between the groups with and without, nor between improved and not-improved. (5) By questionnaire those who became careful about ventilation reached 92%.

23189 (DOE/ER/60493—1-Vol.2, pp 727-731) **Carpeting in schools as an indoor pollutant.** Hanson; Leif; Bach; Ibsen, E.K. (National Health Board, Denmark). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

569 school children were monitored during a 4-weeks period with regard to their consumption of medicine, asthma symptoms and school absence. Information about the school indoor climate was required from the children's schools (360). Children from schools with carpeting had an increased severity of asthma compared to children from schools with no carpeting ($p = 0,02$). Including various confounders in the analysis did not influence the result. Confounders variables analyzed were sex, age of the child, place of residence, age of the school, hessian on the walls, sound absorbing ceiling and insulating material. The study indicates that carpeting may be a significant indoor climate factor in patients with asthma.

23190 (DOE/ER/60493—1-Vol.2, pp 768-771) **Indoor pollution - clinical evaluation and treatment.** Johnson, A.R.; Rea, W.J.; Butler, J.R.; Fenyves, E.J. (Environmental Health Center, Dallas, TX). 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

In the US, with an increasing emphasis on energy conservation and potential use of toxic chemically derived home products, illness related to indoor air pollution is increasing yet poorly defined to the general public and medical community. Carcinogenic substances have been and are continually cited and accepted as hazards and pollutants, including inadvertant spills of toxic chemicals, but are not the major cause of illness of indoor pollution. Fortunately in a few cases of sick buildings have made the public and medical community aware of poor indoor air quality leading to less than optimal health. Still in question, is why some individuals are affected and others are not by chronic low levels of indoor pollutants.

23191 (DOE/ER/60493—1-Vol.2, pp 772-776) **Diagnosing the tight building syndrome.** Rogers, S.A. 1987. NTIS, PC A 99. Order Number DE88004514/JAW. (CONF-870853—Vol.2).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Formaldehyde is but one of many chemicals capable of causing Environmentally Induced Illness (E.I.). The spectrum of symptoms its may induce includes attacks of headache, flushing, laryngitis, dizziness, nausea, extreme weakness, arthralgia, exhaustion, inability to think clearly, arrhythmia or muscle spasms. The nonspecificity of such symptoms can baffle physicians from many specialties. Presented herein is a simple office method for demonstrating that formaldehyde is among the etiologic agents triggering these symptoms. The very symptoms that patients complain of can be provoked within minutes, and subsequently abolished, with an intradermal injection of the appropriate strength of formaldehyde. This aids in convincing the patient so he can initiate measures to bring his disease under control.

23192 (DOE/ER/60493—1-Vol.3, pp 25-29) **Domestic smoke pollution and acute respiratory infection in Nepal.** Pandey, M.R.; Neupane, R.P.; Gautam, A. (Mrigendra Medical Trust, Nepal, India). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Acute respiratory infection (ARI) is the cause of death of at least 5 million children under 5 years of age. Most of these deaths occur in developing countries. Domestic smoke pollution is very common in many parts of the developing world. The present study has been undertaken in a rural community of the hilly region of Nepal to find out if domestic smoke pollution is a risk factor of ARI in infants and children. A strong positive correlation was found between moderate and severe ARI and exposure to domestic smoke pollution as measured by the time spent near the fireplace.

23193 (DOE/ER/60493—1-Vol.4, pp 3-8) **Determination of health effects of indoor air pollution.** Stolwijk, J.A.J.; Pierce, J.B. (Yale Univ. School of Medicine, New Haven, CT). 1987. NTIS, PC A 07. Order Number DE88004516/JAW. (CONF-870853—Vol.4).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Indoor air pollution is characterized by a wide range of concentrations in different indoor spaces. An approach is presented which allows the consistent estimation of the total public health impact on a population exposed to such wide ranges, if the exposure-response relationship is known or can be reasonably estimated. The proposed method allows the development of priorities for research, and for control measures. It also makes it possible to make estimates of the public health benefit of reducing indoor and outdoor exposures.

23194 (GSF—10/87, pp 77-94) **Forest trees under the impact of extreme weather and immissions. Influence of O/sub 3/ and SO/sub 2/ on parasitic fungi and the predisposition of young spruces (Picea abies [L.] Karst.).** Schuett, P.; Lang, K.J.; Dotzler, M.; Holdenrieder, O. (Muenchen Univ., Germany, F.R. Lehrstuhl fuer Forstbotanik). Mar 1987. (In German). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88752006/JAW. (CONF-8610391—).

From Symposium on climate and weather as related to the novel forest disease; Neuherberg, F.R. Germany (13 Oct 1986).

In several series of experiments the influence of SO/sub 2/, O/sub 3/ and SO/sub 2/ + O/sub 3/ on spore germination, the growth of germ tubes, and the growth of the mycelium of such fungi was tested as occur in forest plants as pathogens or debility parasites. Another experiment aimed moreover to influence the disposition of young spruce to Rhizosphaera kalkhoffii and Lophodermium piceae by fumigation with the above-mentioned air pollutants. The results can be summarized as follows: Under the experimental conditions given, no proof of a change of the buffer capacity of spruce needles of different age in any specific direction was to be obtained. To be sure, the infection experiments with young spruce did lead to a slightly increased rate of reisolation of Rhizosphaera, but no differences depending on fumigation variations were observed.

23195 (GSF—10/87, pp 100-114) **Light as a stress factor in woody plants.** Wild, A. (Mainz Univ., Germany, F.R. Inst. fuer Allgemeine Botanik). Mar 1987. (In German). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88752006/JAW. (CONF-8610391—).

From Symposium on climate and weather as related to the novel forest disease; Neuherberg, F.R. Germany (13 Oct 1986).

The results of our physiological and cytomorphological investigations on spruce from two locations in the Hunsrueck and in the Taunus mountains consistently show the presence of early damage to the cell membranes. This membrane damage already occurs to a substantial extent in the green needles of damaged trees. The chloroplasts of the mesophyll cells are sites of early occurrence of damaging effects. The loss of chlorophyll and of electron transport and RubP carboxylase activity associated with the damage to the thylakoids leads to an impairment of assimilatory activity both at times of low incident light and under conditions of light saturation. The increased photosensitivity which is manifested phenotypically in the spruce by yellowing of the needles at the top side of the branches is to be regarded as the result of primary damage to the thylakoids.

23196 (GSF—10/87, pp 115-130) **Physiological reactions to climate-dependent stress in trees at the forest limit.** Havranek, W.M. (Forstliche Bundesversuchsanstalt, Innsbruck, Austria. Aussenstelle fuer Subalpine Waldforschung). Mar 1987. (In German). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88752006/JAW. (CONF-8610391—).

From Symposium on climate and weather as related to the novel forest disease; Neuherberg, F.R. Germany (13 Oct 1986).

Climate-dependent stress occurs regularly at forest limits and entails at the tree line in winter what is called frost dryness. Measurement of saturation water content, cuticular transpiration and the rate of drying out proved experimentally that with increasing altitude and as the vegetation period grows shorter or becomes disadvantageous in other respects, the maturation and evaporation protection of spruce, arolla pine, and larch shoots is distinctly impaired thereby fulfilling an essential precondition of frost dryness. A comparison of the length of 14 vegetation periods at at the forest limit with the incidence of winter damage indicates that trees sustain much severer damage after short vegetation periods, and here again particularly after such ones that are terminated early in autumn by frost setting in (1972), than after a short vegetation time with warm autumn and mild winter stress (1980).

23197 (GSF—10/87, pp 139-143) **Statistical methods for, and limits of, the recording of the association between climate and forest disease.** Cehak, K. (Vienna Univ., Austria. Inst. fuer Meteorologie und Geophysik; Zentralanstalt fuer Meteorologie und Geodynamik, Vienna, Austria). Mar 1987. (In German). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88752006/JAW. (CONF-8610391—).

From Symposium on climate and weather as related to the novel forest disease; Neuherberg, F.R. Germany (13 Oct 1986).

Statistics tries to detect causes for the diseases of a certain forest. In the biological sciences, this is achieved by the method of variance analysis, a method verifying, by complex procedures, influences on the mean values. To advance a little further even, multiple regression analysis is employed. Both methods are briefly described.

23198 (GSF—10/87, pp 144-155) **Reaction kinetics of spruce in different damage regions of Bavaria.** Roehle, H. (Muenchen Univ., Germany, F.R. Lehrstuhl fuer Waldwachstumskunde). Mar 1987. (In German). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88752006/JAW. (CONF-8610391—).

From Symposium on climate and weather as related to the novel forest disease; Neuherberg, F.R. Germany (13 Oct 1986).

To obtain representative data bases on the growth curves of damaged stands in Bavaria, additional measuring areas were created, as test areas observed over long periods in the main regions of damage did not suffice. For the purpose of deducing suitable quantities to estimate the losses of increment damaged forest stands sustain, current yield tables prove inadequate. For a comprehensive analysis of growth curves it is also necessary to consider the influence of growth-relevant climate parameters, in order to allow to clearly separate weather-related factors and damage-related quantities of harm from each other.

23199 (GSF—10/87, pp 156-164) **Dendroclimatological investigations of spruces from an area of forest disease within the Forestry Office of Farchau/Ratzeburg.** Eckstein, D.; Bauch, J. (Hamburg Univ., Germany, F.R. Ordinariat fuer Holzbiologie). Mar 1987. (In German). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88752006/JAW. (CONF-8610391—).

From Symposium on climate and weather as related to the novel forest disease; Neuherberg, F.R. Germany (13 Oct 1986).

The dendroclimatological analysis of 30 spruces from an area of forest disease in the territory of the Forestry Office of Farchau/Ratzeburg has provided obvious clues to the incidence of a disturbance factor around 1954. There is only the slightest agreement between the classification as non-damaged and damaged, carried through visually on the basis of the tree-ring sequences, and the classification of damage according to the appearance of the crown and needles. The growth of the spruces on that site is characterized predominantly by the precipitations from May to July. But periods of extreme weather are out of the question as events triggering the damage. So, complex influences from the agglomeration of Hamburg are considered as possible causes.

23200 (GSF—10/87, pp 165-174) **Connections between phases of growth in sequences of tree-rings and environmental conditions in Switzerland.** Schweingruber, F.H. (Eidgenoessische Anstalt fuer das Forstliche Versuchswesen, Birmensdorf, Switzerland). Mar 1987. (In German). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88752006/JAW. (CONF-8610391—).

From Symposium on climate and weather as related to the novel forest disease; Neuherberg, F.R. Germany (13 Oct 1986).

The investigation of the conifers includes a comparison of the condition of crowns (density of needles) with events of change (abrupt changes of increment), recognition of increment patterns within trees, at sites, and in regions, as well as the detection of causes for abrupt changes of increment. The material investigated stems from forests of different parts of Switzerland. The selection was made on the basis of ecological criteria.

23201 (GSF—10/87, pp 175-184) **Experimental verification of the impact of weather-dependent stress in exposure chambers.** Rehfuess, K.E.; Bosch, C. (Muenchen Univ., Germany, F.R. Lehrstuhl fuer Bodenkunde). Mar 1987. (In German). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88752006/JAW. (CONF-8610391—).

From Symposium on climate and weather as related to the novel forest disease; Neuherberg, F.R. Germany (13 Oct 1986).

On the basis of observations and hints from increment and needle analyses to establish deep-frost and frost-shock effects in fir and spruce it is not unreasonable to assume that these, jointly with other stress factors, are the factors regulating the current disease process. The pilot experiments of the Munich task force on air pollutants (MAGL) and of the CERL group at Leatherhead near London provided clues to a lowering of frost hardiness from insufficient Mg and Ca nutrition and a relationship between ozone fumigation and reduced frost hardiness.

23202 (GSF—10/87, pp 185-198) **Connections between site characteristics and damage in spruce in the Bavarian Alps - clues to a possible participation of climatic factors?.** Moessmer, R. (Bayerisches Forstamt Wolfratshausen, Germany, F.R.). Mar 1987. (In German). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88752006/JAW. (CONF-8610391—).

From Symposium on climate and weather as related to the novel forest disease; Neuherberg, F.R. Germany (13 Oct 1986).

Stripwise aerial monitoring taking an infrared colour film served as a basis for obtaining data. Systematic samples of the film were visually evaluated, the part areas of Garmisch and Reichenhall being more densely represented. Though it is true that the relations between damage to spruce and the site characteristics geology and exposure, respectively the sum of radiation, point to an aggravating influence from an unfavourable water balance of the soil, they seem to exclude a primary effect of drought due to climate. Moreover, the distribution of damage according to height above sea level, exposure, and direction of the forest front revealed that wind as a transport medium and the stratification of air masses respectively the vertical exchange of air play a part in the distribution of damage in the terrain.

23203 (GSF—10/87, pp 199-208) **Connections between periods of damage and climatic factors since the middle of the last century.** Cramer, H.H. Mar 1987. (In German). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88752006/JAW. (CONF-8610391—).

From Symposium on climate and weather as related to the novel forest disease; Neuherberg, F.R. Germany (13 Oct 1986).

Tree-ring widths are clearly dependent on the amount of precipitation supplied. This leads to the conclusion that trees in the high mountain ranges are on average supplied with less than the optimum quantity of water. In this connection it is to be borne in mind that the quality of sites and profoundness of soils decrease in general as altitude increases, so that the supply of humidity becomes the decisive factor. A renewed analysis of the years of drought around 1921 seems appropriate, as they represent, at the same time, a period of massed damage.

23204 (GSF—10/87, pp 209-226) **Summers of drought and rich in sunshine in Germany as possible damage factors for forests and the plant kingdom.** Schmidt, M. (Max-Planck-Institut fuer Aeronomie, Katlenburg-Lindau, Germany, F.R.). Mar 1987. (In German). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88752006/JAW. (CONF-8610391—).

From Symposium on climate and weather as related to the novel forest disease; Neuherberg, F.R. Germany (13 Oct 1986).

The rise of forest disease in central Europe coincides with an unusual frequency of summers that were too dry and, in part, rich in sunshine, which have to be assessed as additional stress factors for the entire plant kingdom. The frequency distribution of the summers of drought in the last 5 years roughly shows a gradient from north to south in Germany corresponding to the distribution of forest decline. In those summers there is, apart from the stress to forests from drought, increases formation of a further important air pollutant to forests in the form of ozone.

23205 (GSF—10/87, pp 255-264) **Effects of the variability of the warmth and humidity climate on the ion cycle in forest ecosystems and the chemical condition of the soil.** Ulrich, B. (Goettingen Univ., Germany, F.R. Inst. fuer Bodenkunde und Waldernaehrung). Mar 1987. (In German). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88752006/JAW. (CONF-8610391—).

From Symposium on climate and weather as related to the novel forest disease; Neuherberg, F.R. Germany (13 Oct 1986).

The stress associated with the change from cool and humid to warm and dry weather periods has so far been attributed to the water balance. A theoretical analysis of the ion balance in ecosystems shows that a further climatic effect is triggered via the decoupling of the ion cycle in the ecosystem. During the warm and dry periods and especially when dried-out soils are rehumidified, the decomposition and mineralization of the organic substance is accelerated at a higher pace than the ion uptake and formation of vegetable substance. So the fact that mineralization is faster means an excessive rise in acidity.

23206 (GSF—10/87, pp 276-284) **On the influence of weather on invertrebrates in the ecosystem 'spruce forest'.** Funke, W. (Ulm Univ., Germany, F.R. Abt. Oekologie und Morphologie der Tiere). Mar 1987. (In German). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88752006/JAW. (CONF-8610391—).

From Symposium on climate and weather as related to the novel forest disease; Neuherberg, F.R. Germany (13 Oct 1986).

The fluctuations of the population densities of soil organisms can only in part be explained by intra and inter-specific relationships. Obviously more important was, in spruce stand near Ulm, the weather, with a certain key role being ascribed to the year 1980. That year was both very cool and very dry and is believed to have been largely responsible, together with other factors, for the sharp decline in population density in 1981, especially of the most important litter decomposers. That weather influences the population densities is also supported by the findings on a part area artificially irrigated since 1979. From the influence of weather on soil organisms, such influences are also derived with regard to the vitality of trees. Particular attention is paid in this connection to long-term alterations of temperature and the duration of solar radiation.

23207 (GSF—10/87, pp 285-290) **Are climate and the novel forest disease related to one another? A concise report from South Tyrol.** Minerbi, S. Mar 1987. (In German). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88752006/JAW. (CONF-8610391—).

From Symposium on climate and weather as related to the novel forest disease; Neuherberg, F.R. Germany (13 Oct 1986).

From the evaluation of data compiled for a number of years on precipitation amounts (1921-84), temperature curves and high-altitude wind curves (1975-84), a distinct decrease of precipitation was established for South Tyrol in comparison with the mean annual value for many years since the 1960s. However, a statistically corroborated relationship between the novel spruce forest disease recorded in 1984 and the precipitation deficit in summer could not be derived. But one does see a gradient indicating that the proportion of damage increases along with the water deficit.

23208 (NIPER—302) **Protocol for laboratory research on degradation, interaction, and fate of wastes disposed by deep-well injection: Final report.** Collins, A.G.; Crocker, M.E. (National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA)). Dec 1987. Contract FC22-83FE60149. 67p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88006288/JAW.

The objective of this research investigation was to develop a laboratory protocol for use in determining degradation, interaction, and fate of organic wastes disposed in deep subsurface reservoirs via disposal wells. Knowledge of the ultimate fate of deep-well disposed wastes is important because provisions of the Resource Conservation and Recovery Act (RCRA) require that by August 1988, the Environmental Protection Agency (EPA) must show that the disposal of specified wastes by deep-well injection is safe to human health and the environment, or the practice must be stopped. The National Institute for Petroleum and Energy Research (NIPER) developed this protocol primarily by transferring some of its expertise and knowledge of laboratory protocol relevant to improved recovery of petroleum. Phenol, because it is injected into deep, subsurface reservoirs for disposal, was selected for study by the EPA. Phenol is one waste product that has been injected into the Frio formation; therefore, a decision was made to use phenol and sedimentary rock from the Frio formation for a series of laboratory experiments to demonstrate the protocol. This study investigates the adsorption properties of a specific reservoir rock which is representative of porous sedimentary geologic formations used as repositories for hazardous organic wastes. The developed protocol can be used to evaluate mobility, adsorption, and degradation of an organic hazardous waste under simulated subsurface reservoir conditions. 22 refs., 13 figs., 16 tabs.

23209 (PB—88-132220/XAB) **Individual variability in the magnitude of acute respiratory responses to ozone exposure.** McDonnell, W.F. (Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab.). Nov 1987. 34p. (EPA—600/D-87/335). NTIS, PC A03/MF A01.

Individuals differ widely in the magnitude of their acute respiratory responses to ozone exposure. These differences have been shown to be quite reproducible, indicating that they are the result of differences in intrinsic responsiveness to ozone. This difference in responsiveness is of significance because the ambient ozone concentration in several urban areas frequently exceeds levels at which some individuals experience acute health effects. The purpose of this paper is to describe the distributions of the individual changes in lung function as a consequence of ozone exposure and to discuss the potential sources of and the implications of this variability in acute responsiveness to ozone exposure.

23210 (PB—88-132915/XAB) **Effects of breathing air containing contaminants such as CO_2, CO and hydrocarbons at 1 and 5 atmospheres.** Benignus, V.A. (Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab.). Nov 1987. 69p. (EPA—600/D-87/348). NTIS, PC A04/MF A01.

The neural and behavioral effects of air contaminants such as CO_2, CO, and hydrocarbons are reviewed. Each contaminant or contaminant class is reviewed separately and then an attempt is made to estimate effects of combinations of contaminants. The effects are reviewed for both normobaric and hyperbaric conditions. Rough dose-effects curves were constructed from data found in the literature.

23211 **Speciation of trace inorganic contaminants in plants and bioavailability to animals: an overview.** Cataldo, D.A.; Wildung, R.E.; Garland, T.R. (Battelle, Pacific Northwest Lab., Richland, WA). *Journal of Environmental Quality;* **16**: No. 4, 289(Oct-Nov 1987). Contract AC06-76RL01830.

The movement of both essential and pollutant trace elements through agricultural food chains is a complex problem, influenced in part by plant-mediated changes in trace element speciation that may alter the rate and extent of gastrointestinal absorption after ingestion of plant tissues by animals. An overview is provided of a series of investigations undertaken to describe the processes governing the chemical behavior of several cations (Pu, Ni, Cd, and Fe) and anions (Tc, Se, and S) during transport in the plant xylem and after deposition in plant tissues. Cations were generally present in xylem exudate as organic acid. amino acid, and peptide complexes specific to the element, whereas anions tended to remain in the inorganic forms initially absorbed by the root. Once deposited in tissues, both cations and anions were associated with more complex, but soluble, plant metabolites. The cations (Pu, Ni, Cd) were directly associated with $>$ 10,000 molecular weight proteins, where the anions (Se and Tc) appeared to undergo chemical reduction and incorporation into proteins using enzymatic processes functioning for S metabolism. The importance of these plant processes of gastrointestinal absorption was demonstrated for Pu and Tc, which differed markedly in their behavior in plants and animals.

23212 Phytoavailability of boron from organic sources. Burkman, W.G.; Adriano, D.C.; Afre, J.L. (Savannah River Ecology Lab., Aiken, SC). *Journal of Environmental Quality;* 16: No. 4, 416(Oct-Dec 1987). Contract AC09-76SR00819.

Experiments were conducted to determine the use of certain organoborates as potential sources of B for plant nutrition and to assess the sensitivity to them by different crop species. Of particular interest was sodium tetraphenylboron (NaTPB), a specific precipitant for radiocesium. For comparison, the inorganic source of B, boric acid (BA), was used as the control source of B. Greenhouse experiments indicated the following: (i) BA and NaTPB produced similar toxicity symptoms in the various crops studied; (ii) the order of sensitivity to NaTPB for various species followed the usual order for B toxicity, i.e., members of the bean (Phaseolus spp.) family are most sensitive, whereas cereals and chard (Beta vulgaris L.) were least sensitive; (iii) crop dry matter yields can best be predicted by the applied soil B on a coarse-textured soil than by the plant B concentration; and (iv) at the same B level added to soil, NaTPB was more deleterious to plant growth than BA. A germination study indicated that at equal levels of B in substrate solutions, the organo-borates, NaTPB, and diphenylboric acid were more injurious than BA to root and shoot growths, providing more conclusive evidence that the organic constituents of these compounds are also phytotoxic.

23213 Investigations of the toxicological action of spark-decomposed SF_6 in mammalian cells. Griffin, G.D.; Kurka, K.; Sauers, I.; Easterly, C.E. pp 174-181 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

From 5. international symposium on gaseous dielectrics; Knoxville, TN, USA (3 May 1987).

The biological/toxicological activity of spark-decomposed SF_6 has been investigated in a cell culture assay system, using cell survival as the measure of biological activity. Spark-decomposed SF_6, at a given total spark energy, shows a stronger cytotoxic effect toward CHO (Chinese hamster ovary) cells than toward V79 (Chinese hamster lung) cells. Cytotoxicity results from a synthetic mixture (designed to mimic the byproducts produced by spark decomposition) confirmed previous mixture studies, in that the mixture was without cytotoxic activity. A spark-decomposed SF_6 sample, sparked to the appropriate energy to contain nearly the same concentrations of byproducts as the mixture, was assayed at the same time, and was found to show strong cytotoxic activity. Disulfur decafluoride (S_2F_{10}) was tested in the cytotoxicity assay system at concentrations of 100-5000 ppm in SF_6, all of which produced significant cytotoxicity. The CHO cells showed greater sensitivity than the V79 to the toxic action of S_2F_{10}. Heating is reported to decompose S_2F_{10}. Accordingly, a sample of S_2F_{10} was heated to 250 C for 2 h, and subsequently tested for cytotoxicity. Heating abolished the cytotoxicity. Samples of spark-decomposed SF_6 were heated as above, and tested for cytotoxic activity in comparison to samples of spark-decomposed SF_6 which were from the same sparked sample, but had not been heated. Heating significantly reduced the cytotoxicity of these samples. These data suggest that S_2F_{10} may be present in spark-decomposed SF_6 prepared in our system, and the S_2F_{10} may be a significant contributor to the overall toxicity of spark-decomposed SF_6, although there are other byproducts and/or factors which may also play a role in the cytotoxic activity of this electrically-stressed gas. 11 references, 4 tables.

23214 Assay of SF_6 and spark-decomposed SF_6 for mutagenic activity in the CHO/HGPRT mammalian cell system. Kurka, K.; Griffin, G.D. pp 213-217 of Gaseous dielectrics V. Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). (CONF-870516—).

From 5. international symposium on gaseous dielectrics; Knoxville, TN, USA (3 May 1987).

The potential mutagenic (and cytotoxic) activity of SF_6 and spark-decomposed SF_6 was investigated in an in vitro mammalian cell culture system using Chinese Hamster Ovary (CHO) cells. The CHO cells were exposed to the gases in vacutainer tubes which were constantly rotated. After a 4 h exposure the mutagenic and cytotoxic activity was assayed with the CHO/hypoxanthine-guanine phosphoribosyl transferase (CHO/HGPRT) system. Results indicated that SF_6 was neither cytotoxic nor mutagenic to CHO cells. Spark-decomposed SF_6 was found to be strongly cytotoxic (~ 80% cell death following 4 h exposure to 2 kJ spark discharge in 60 cm^3 at 1000 torr of SF_6) but not mutagenic. Increasing spark energy increased cytotoxicity but the spark samples remained nonmutagenic. The CHO/HGPRT system was coupled with a metabolic activation (S9 fraction) system used for detecting promutagens. When exposures were carried out in the presence of S9 fraction, SF_6 was still neither cytotoxic nor mutagenic; spark-decomposed SF_6 was again strongly cytotoxic but not mutagenic. It appears that SF_6 and sparked SF_6 are neither promutagens nor direct acting mutagens in the CHO/HGPRT system. Studies have begun using a more mutagenically sensitive subclone of the CHO cells known as CHO-AS_{52}. Initial results with CHO-AS_{52} cells are equivocal with certain exposures to sparked SF_6 eliciting mutagenesis and replicate exposures that do not. Further experiments are required to confirm any mutagenic activity in the CHO-AS_{52} cell line. 9 references, 1 table.

5604 Other Environmental Pollutant Effects

REFER ALSO TO CITATION(S) 22302, 23084, 23085

23215 (AD-A—186922/1/XAB) Supersonic and subsonic aircraft noise effects on animals: a literature survey. Final report, 15 October 1985-15 October 1986. Kull, R.C.; Fisher, A.D. (Air Force Aerospace Medical Research Lab., Wright-Patterson AFB, OH (USA)). 1 Dec 1986. 57p. (AAMRL-TR—87-032). NTIS, PC A04/MF A01.

The literature was searched concerning the effects of supersonic and subsonic aircraft noise on animals. The search revealed many review papers of prior research accomplished, but few actual research papers. Out of all the reviews, Dufour's work is the most comprehensive. Many of the papers are anecdotal in nature and add little to our scientific knowledge - strictly circumstantial evidence. The literature reveals few effects on animals due to sonic booms. The effects of subsonic noise, however, needs much more investigation. One of the biggest problems with the research in this area is the lack of controls, lack of standardized ways of recording data and evaluating behaviors, and the number of variables involved. Specific recommendations to fill some of the technological gaps include a sonic boom study on a ground-nesting shorebird, effects of subsonic aircraft noise on endangered species, long term physiological effects causing immunosuppression, and noise versus visual aircraft stimuli effects.

23216 (AD-A—187607/7/XAB) Eye-controlled simulation of laser damage on the retina. Final report, 15 December 1983-28 February 1986. Bertera, J.H. (Massachusetts Univ., Amherst (USA). Dept. of Psychology). 20 Oct 1986. 42p. NTIS, PC A03/MF A01.

A scotoma or blindspot was generated in human subjects using an eye-controlled computer display to simulate retinal effects of accidental laser exposure. Visual search time and eye behavior were measured during search for acuity targets while a simulated brightspot or scotoma afterimage blocked the foveal visual information. This simulated laser aftereffect impaired visual search performance 90%-110%. Simulated foveal scotoma deficits were still present when target size, search element density and display brightness improved peripheral visibility. The simulated scotoma probably required subjects to employ the unaffected peripheral retina for target recognition and may have caused disturbances in eye-fixation programming. A technique was also developed for simulating the slow decay of a laser-induced afterimage. Preliminary data suggests that the subjects tend to look left relative to their normal eye fixation position in order to bring the search target to an area of retina just outside the site of simulated laser exposure; the tendency appeared to be reduced as the simulated scotoma faded. Development of the simulated scotoma technique to evaluate the effects of laser exposure on visual performance in human subjects shows promise because the size, intensity, and position on the retina of the simulated exposure can all be controlled with complete safety. The method may have application for demonstrations and training, which might serve as countermeasures to the impairments in visual performance caused by central scotomas.

23217 (DOE/ER/60493—1-Vol.3, pp 452-456) **Interactions of noise and thermal factors on human behavior.** Hygge, S. (National Swedish Institute for Building Research, Gaevle). 1987. NTIS, PC A 25. Order Number DE88004515/JAW. (CONF-870853—Vol.3).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Whenever thermal and noise conditions are changed, one, but not the other, of two outcomes on human behavior and performance is expected. Either the effect of one of the factors is the same across all levels of the other factor, which is what is meant by combined effects. Or the effects of one of the factors varies with the level of the other, which is the meaning of an interaction. This paper attempts to review interactions and combined effects of noise and thermal conditions on human behavior and performance. The dependency of choice of measurement scale on the validity of statements about interactions or combined effects is discussed. Theoretical reasons for choosing one, rather than another, of available dependent measures are outlined.

23218 (INIS-mf—10846, pp 23) **Problems in protection of man from laser radiation.** Izrael, M. Nov 1984. (In Bulgarian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

23219 **(PB—88-134416/XAB) Laser beam effect on visual functioning.** Court, L. (Centre de Recherches du Service de Sante des Armees, 92 - Clamart (France)). May 1987. 64p. (In French). (CRSSA—2/RER). NTIS, PC E04/MF E04.

The objective of the study was to determine the minimum energy levels capable of causing an irreversible alteration in retinal functioning and to compare results with proposed exposure limits. Experiments were conducted using rabbits and primates that had been exposed to a dye-laser impulse and a double-frequency YAG laser impulse, or to an impulse string of fewer than 30 shots. The authors concluded that, for point sources, current proposed limits are on the whole justified; for extended sources, the proposed limits are too high; for repeated impulses of fewer than 30 seconds, maximum, acceptable exposure seems to be justified.

23220 **Electromagnetic fields and public health.** Aldrich, T.E.; Easterly, C.E. (Oak Ridge National Lab., TN). *Environmental Health Perspectives;* 75: 159-171(Nov 1987).

A review of the literature is provided for the topic of health-related research and power frequency electromagnetic fields. Minimal evidence for concern is present on the basis of animal and plant research. General observation would accord with the implication that there is no single and manifest health effect as the result of exposure to these fields. There are persistent indications, however, that these fields have biologic activity, and consequently, there may be a deleterious component to their action, possibly in the presence of other factors. Power frequency electromagnetic field exposures are essentially ubiquitous in modern society, and their implications in the larger perspective of public health are unclear at this time. Electromagnetic fields represent a methodological obstacle for epidemiologic studies and a quandary for risk assessment; there is need for more data. 133 references.

57 HEALTH AND SAFETY

23221 **(CONF-880156—1) Developing and implementing the training required by SARA/OSHA 1910.120.** Copenhaver, E.D.; Wells, S.M.; White, D.A. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 12p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002957/JAW.

From DOE and DOE contractor's occupational health and safety conference; Oakland, CA, USA (26 Jan 1988).

A number of laws and regulations dealing with hazardous materials control must be implemented in developing and implementing adequate training programs for DOE facilities. Some of the newest and most comprehensive are the requirements included in the Superfund Amendments and Reauthorization Act (SARA), as implemented by the Occupational Safety and Health Administration (OSHA). Specific provisions exist for initial and review training of employees engaged in hazardous waste operations that could expose them to safety and health hazards. This presentation will outline how the Environmental Compliance and Health Protection Technical Resources and Training Program, working with other ORNL groups in environmental compliance, health protection, and waste operations, establishes the specific training requirements and implements a full range of courses designed to meet ORNL needs. It will focus on course development and implementation strategies. 13 refs.

58 GEOSCIENCES

23222 **(PB—88-142393/XAB) International geosphere-biosphere program: a study of global change. Final report.** (International Council of Scientific Unions, Paris (France)). 4 Aug 1986. 27p. NTIS, PC E03/MF A01.

A better understanding of the Earth and its immediate environment is essential if we are to improve our ability to detect and to respond to warnings of significant global change. Although the world community of scientists has in the last 30 years successfully completed a wide range of international programs. The program will be tightly focused, with emphasis on interactive processes that are not addressed by other existing programs. Topics suggested for early emphasis in the IGBP include: (1) studies of biogeochemical cycles; (2) studies of the ocean euphotic zone; (3) studies of soil dynamics and soil chemistry; and (4) studies of variable solar inputs to the Earth. Emphasis is also put on the need for development of an adequate global data and information system, which must be an integral part of the program.

5801 Geology And Hydrology

REFER ALSO TO CITATION(S) 22156, 22512, 22513

23223 **(NAGRA-NTB—84-49) FEM 301 - a three dimensional model for groundwater flow simulation.** Kiraly, L. (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Jan 1985. 150p. Nagra, CH-5401 Baden, Switzerland.

The purpose of this report is to describe program FEM 301. Program FEM 301 is a three-dimensional, finite element numerical model which solves the steady-state groundwater flow equation. Following a brief description of the mathematical model upon which the numerical model is based, the finite element approximation to the flow equation is presented. The solution method employed by FEM 301 is the frontal elimination technique of Irons. The general structure of program FEM 301 is described as are the required input files and the generated output file. The listing of FEM 301 is included as Annex A3. As numerous pre- and post-processing routines have been developed specifically for use with FEM 301 they are also presented. Several sample problems and verification tests depict the application of FEM 301 to typical hydrogeologic problems. The principal application of FEM 301 has been, however, to evaluate the deep crystalline groundwater flow regime in central northern Switzerland. This application is described in a companion report NTB 84-50.

23224 Measurement of cosmogenic /sup 36/Cl/Cl in young volcanic rocks: An application of accelerator mass spectrometry in geochronology. Leavy, B.D.; Phillips, F.M.; Elmore, D.; Kubik, P.W.; Gladney, E. (Los Alamos National Lab., NM, USA. Earth and Space Sciences Div.; New Mexico Inst. of Mining and Technology, Socorro, USA. Dept. of Geoscience; Argonne National Lab., IL, USA. Environmental Research Div.; Rochester Univ., NY, USA. Nuclear Structure Research Lab.; Los Alamos National Lab., NM, USA. Health Safety and Environment Div.). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **29**: No. 1/2, 246-250(Nov 1987). (CONF-8704112—).

From 4. international symposium on accelerator mass spectrometry; Ontario, Canada (27 Apr 1987).

We have measured /sup 36/Cl/Cl ratios in a number of young volcanic rocks in order to test the feasibility of using /sup 36/Cl buildup as a geochronometer for materials less than about 700 000 years old. All of the analyzed rocks have been dated independently using K-Ar or other radiometric dating methods and have exposure histories that are known or can be reasonably assumed. Measured /sup 36/Cl/Cl ratios in these rocks show a buildup with time that is in good agreement with the calculated in situ / sup 36/Cl buildup curve. These analyses indicate that AMS measurement of /sup 36/Cl buildup in young rocks is a potentially powerful new method for dating materials that had previously been undatable, and as such will have broad applications in volcanology, tectonics, geophysics, and Quaternary research.

5802 Geophysics

23225 (AD-A—187581/4/XAB) Liquefaction susceptibility of fine-grained soils: preliminary study report. Final report, September 1985-March 1986. Chang, N.Y. (Colorado Univ., Denver (USA). Dept. of Civil Engineering). Sep 1987. 77p. NTIS, PC A05/MF A01.

Soil liquefaction, a hazardous ground failure induced by strong motion earthquakes, can cause catastrophic damage to structures such as dams, bridges, power plants, and water-front structures and may involve great losses of life. Examples of liquefaction and resulting damage were observed during the Alaska (1964), Niigata, Japan (1964), and Tangshan, China (1976), earthquakes. Ground failure due to earthquake-induced soil liquefaction may manifest itself as excessive settlement, loss of bearing capacity, sand boiling, and flow slides. The liquefaction potential of clean sands has been studied extensively for the last two decades. However, case histories revealed that liquefied sands were seldom clean. They may contain various percentages of silt or clay or both. In fact, the Chinese observation in the Tansghan earthquake indicated that some cohesive soils may have liquefied. If this indeed had happened, then structures underlain by fine-grained soils, with a marginal safety factor based on the liquefaction criteria normally applied to sands, may actually be unsafe. Thus there is an urgent need for establishing new criteria for the liquefaction susceptibility of soils to include those identified as fine-grained. The author, Professor N.Y. Chang of the University of Colorado at Denver, visited several Chinese agencies and and universities in and near Beijing, China, in the summer of 1985 in an attempt to investigate and verify reported data on the liquefaction of cohesive soils during the Tangshan earthquake of 1976 and to negotiate cooperative research into the problem. This report presents the result of supportive literature review and the findings of the China trip.

23226 (NAGRA-NTB—84-43) Geophysical investigation program, Northern Switzerland: refraction-seismic measurements 84. Fromm, G.; Driessen, L.; Lehnen, I. (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Jan 1985. 43p. (In German). Nagra, CH-5401 Baden, Switzerland.

Acting on instructions from the SGPK/Nagra working group (Baden, Switzerland), PRAKLA-SEISMOS GmbH, Hanover, planned, processed and interpreted seismic-refraction measurements in northern Switzerland; CGG, Massy (France) was responsible for carrying out the field work. The aim of the survey was to investigate the shape and depth of a regional, WSW-ENE striking Permocarboniferous trough which underlays the mesozoic sediments of the Tabular Jura. The crystalline basement surface and possibly other geological boundaries were to be identified on the basis of refractor velocities. The recording arrangement included a 36-km spread in the assumed trough axis and four 12-km-long spreads perpendicular to the axis (broad side T) which covered the trough edges. The resulting good quality data indicated two refractors: horizon H5 which is attributable to the lower Permocarboniferous could only be detected in the western half of the spread with any certainty. Horizon H6 probably represents the crystalline basement surface. If anisotropy is taken into account, the refractor velocity closely corresponds to the Gneiss of the WEIACH- and the Granite 3 of the BOETTSTEIN-borehole. This horizon was clearly discernible on all recordings and allowed the approximate mapping of the trough's shape. The assumed strike direction and depth was largely confirmed. In the WSW section the trough is more than 3300 m deep, it rises to - 3000 m in the ESE section and shows only in the east of the survey area a tendency towards a narrower width and shallower depth (depth data relate to the seismic reference datum at 500 m above MSL).

23227 (NAGRA-NTB—84-45) Seismotectonics of Northern Switzerland. Pavoni, N. (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Dec 1984. 51p. (In German). Nagra, CH-5401 Baden, Switzerland.

Comparison of focal mechanisms with local neotectonic structures in Northern Switzerland shows, in many cases, a good correlation between the orientation of nodal planes of the fault-plane solution and the orientation of fault-systems observed at the surface. Focal depths of 10 - 25 km indicate that some of these fault-systems cut deep into the crystalline basement. From the orientation of P-axes and T-axes it is concluded that the upper crust of Northern Switzerland undergoes a NNW-SSE maximum horizontal shortening and a WSW-ENE maximum horizontal extension. The stress field which causes the present seismicity in Northern Switzerland is very similar in its orientation to the stress field of the last 5 to 8 million years which produced the neotectonic deformation.

23228 Spatial patterns of aftershocks of deep focus earthquakes. Willemann, R.J.; Frohlich, C. (Los Alamos National Laboratory, Los Alamos, New Mexico). *Journal of Geophysical Research;* **92**: No. B13, 13927-13943(10 Dec 1987).

This paper presents precise relative relocations for aftershocks of 59 intermediate and deep earthquakes, using P, pP, and PKP arrival times read by us or reported in the literature. These aftershocks included 36 "rupture subevents," occurring within 1 min of the initial event, and 71 "true aftershocks," occurring later and identified statistically as being related to the initial event. We compare the relative locations with the orientations of the Wadati-Benioff zones and with the available focal mechanisms using statistical methods not previously applied to earthquake data. Surprisingly, neither true aftershocks nor rupture subevents cluster along the nodal planes of intermediate or deep earthquake focal mechanisms. Aftershocks more than 20 km from the initial events occur preferentially in the plane of the Wadati-Benioff zone, while those lying closer have isotropically distributed directions. Rupture subevents occur after the travel time of the S wave from the initial event. Larger-magnitude earthquakes generally possess rupture subevents lying farther from the inital event, whereas true aftershocks can occur 50 km or more from initial events having magnitudes as small as 5.3. Except following a few unusually large earthquakes with focal depths of about 100 km, we find no rupture subevents or true aftershocks more than 80 km from the initial hypocenter. The existence of many aftershocks far from nodal planes does not favor models in which deep earthquake failure is simply slip along a planar fault. Rather, the aftershocks may occur in response to a general redistribution of stress caused either by the occurrence of the initial event or, possibly, by nearby continuing phase transition.

23229 Trace element geochemistry of volcanic gases and particles from 1983—1984 eruptive episodes of Kilauea volcano. Crowe, B.M.; Finnegan, D.L.; Zoller, W.H.; Boynton, W.V. (Los Alamos National Laboratory, Los Alamos, New Mexico). *Journal of Geophysical Research;* **92**: No. B13, 13708-13714(10 Dec 1987).

Compositional data have been obtained for volcanic gases and particles collected from fume emitted at the Pu'u O'o vent on the east rift zone of Kilauea volcano. The samples were collected by pumping fume through a filter pack system consisting of a front stage particulate filter followed by four base-treated filters (^{7}LiOH). Particles and condensed phases are trapped on the particulate filter, and acidic gases are collected on the treated filters. The filters are analyzed for 30 elements by instrumental neutron activation analysis. Fume samples were collected from the Pu'u O'o vent for two eruptive episodes: (1) 7 days after episode 11 (cooling vent samples) and (2) the stage of episode 13 (active vent samples).

5803 Mineralogy, Petrology, And Rock Mechanics

REFER ALSO TO CITATION(S) 21028

5805 Oceanography

REFER ALSO TO CITATION(S) 22761

64 PHYSICS I

23230 **(INIS-SU—442) Experimental and theoretical physics. Collection.** (AN SSSR, Moscow. Fizicheskij Inst.). 1987. 49p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88780052/JAW.

Kratkie soobshcheniya po fizike.; no. 4.

Individual abstracts were prepared for the reports in the collection of Soviet research reports. (DWL)

6401 Astrophysics And Cosmology

REFER ALSO TO CITATION(S) 22100, 22217, 22230, 22514, 22566, 23224, 23470, 23551

23231 **(AD-A—186836/3/XAB) RSTN (Radio Solar Telescope Network) observations of the 16 February 1984 cosmic-ray flare.** Cliver, E.W.; Gentile, L.C.; Wells, G.D. (Air Force Geophysics Lab., Hanscom AFB, MA (USA)). Jul 1987. 5p. (AFGL-TR—87-0297). NTIS, PC A02/MF A01.

Pub. in Solar-Geophysical Activity Reports for STIP Interval XV, 12-21 February 1984 Ground Level Event and STIP Interval XVI, 20 April-4 May 1984 Forbush Decrease, Rept. UAG-96, 55-57(Jul 1987).

The radio Solar Telescope Network (RSTN) are located at Sagamore Hill (Massachusetts), Palehua (Hawaii), and Learmonth (Australia). A fourth site at San Vito (Italy) will begin making observations in 1986. The RSTN stations monitor the quiet and disturbed Sun at eight fixed frequencies logarithmically spaced from 245-15400 MHz. The radiometer patrols are operated from sunrise to sunset. Data are stored on magnetic tape with 1 second time resolution and archived at the World Data Center A in Boulder for dissemination to the scientific community. The Palehua site became operational in July 1980, followed by Learmonth in August 1980, and Sagamore Hill in October 1981. Thus digitized radiometer observations of the Sun are available for a significant fraction of the maximum phase of solar cycle 21.

23232 **(AD-A—186839/7/XAB) Scientific highlights of the Study of Travelling Interplanetary Phenomena (STIP) intervals during the SMY/SMA (Solar Maximum Year/Solar Maximum Analysis).** Dryer, M.; Shea, M.A. (Air Force Geophysics Lab., Hanscom AFB, MA (USA)). 1986. 10p. (AFGL-TR—87-0289). NTIS, PC A02/MF A01.

Pub. in Advanced Space Research, Vol. 6, No. 6, 343-351(1986).

The STIP Project was instrumental in the coordination of multi-disciplinary ground-and -space-based synoptic observations and analysis of solar/interplanetary events during the period covered by the Solar Maximum Year and Solar Maximum Analysis. Eight STIP Intervals for coordinated studies were conducted during the SMY/SMA period starting with STIP Interval VII (August 1979) and ending with Interval XIV (20 May - 20 July 1982). These results increased our understanding and knowledge of a variety of phenomena including coronal mass ejections (CMEs) and their in situ shock wave detections within 1 AU; shock physics; acceleration of particles at variously classified shocks by V x B drift and Fermi mechanisms; magnetic clouds; interplanetary disturbances; x-ray imaging of preflare and flare-generated CMEs, and white light imaging of CMEs during SMY by both spacecraft and ground-based instruments. In addition, scientific progress was made on the tracking of disturbances (initiated by flares, eruptive prominences, and coronal holes) into interplanetary space as well as some of their consequences as observed at 1 AU and throughout the heliosphere.

23233 **(AD-A—186845/4/XAB) Solar-flare nuclear gamma rays and interplanetary proton events.** Cliver, E.W.; Forrest, D.J.; McGuire, R.W.; Von Rosenvinge, T.T.; Cane, H.V. (Air Force Geophysics Lab., Hanscom AFB, MA (USA)). 15 Aug 1987. 6p. (AFGL-TR—87-0296). NTIS, PC A02/MF A01.

Pub. in International Union of Pure and Applied Physics, International Cosmic Ray Conference (20th) 61-64(2-15 Aug 1987).

Flare gamma-ray line (GRL) events and solar energetic proton (SEP) events are compared for the period from February 1980 - January 1985 and substantiated earlier results show a lack of correlation between gamma-ray-producing ions and interplanetary protons. This poor correlation results primarily from several large SEP events that originated in flares without detectable gamma-ray-emission. The converse case of GRL events unassociated with SEP events is rare. Evidence is presented which suggests that the ratio of trapped to escaping protons in GRL/SEP flares depends on the spatial scale size and the flare.

23234 **(AD-A—186861/1/XAB) Solar gradual hard x-ray bursts: observations and an interpretation.** Cliver, E.W.; Dennis, B.R.; Kiplinger, A.; Kane, S.; Neidig, D.F. (Air Force Geophysics Lab., Hanscom AFB, MA (USA)). 1986. 5p. (AFGL-TR—87-0293). NTIS, PC A02/MF A01.

Pub. in Advances in Space Research, Vol. 6, No. 6, 249-252(1986).

A recent study of solar gradual hard x-ray bursts is summarized. The data are interpreted in terms of a model involving the acceleration and trapping of electrons in post flare loop systems following coronal mass ejections. A controversy about the classification of the metric continuum that typically accompanies gradual hard x-ray events is addressed.

23235 **(AD-A—186879/3/XAB) Solar-planetary relationships: cosmic rays, solar and interplanetary physics.** Shea, M.A. (Air Force Geophysics Lab., Hanscom AFB, MA (USA)). Apr 1987. 11p. (AFGL-TR—87-0290). NTIS, PC A03/MF A01.

Pub. in Reviews of Geophysics, Vol. 25, No. 3, 641-650(Apr 1987).

This report briefly summarizes the research results in the fields of cosmic radiation, solar, and interplanetary physics (including the interaction of the solar wind with comets) as obtained by scientists in the United States during the quadrennium 1983-1986.

23236 **(AD-A—187027/8/XAB) Peak-flux-density spectra of large solar radio bursts and proton emission from flares.** Cliver, E.W.; Gentile, L.F.; McNamara, L.F. (Air Force Geophysics Lab., Hanscom AFB, MA (USA)). 22 Jun 1984. 6p. (AFGL-TR—87-0298). NTIS, PC A02/MF A01.

Pub. in Proceedings of a Workshop on Solar-Terrestrial Predictions, 212-215(18-22 Jun 1984).

The relationship between u-shaped peak-flux-density microwave spectra and solar-proton events is reexamined for about 200 large (Sp(> or= 2 Ghz) > or = 800 sfu) microwave bursts (1965-1979). The radio spectra fell into two basic classes: U-shaped, with two maxima (> or = 800 sfu) in the range from 200 Mhz to > or = 10 Ghz (59% of all events) and cut-off spectra, with a maximum > or = 800 sfu at f > or = 2 GHz to and Sp(200 MHz) < 100 sfu (18%). Nine percent of the events had intermediate spectra with a maximum > or = 800 sfu at f > or = 2 GHz and 100 sfu < or = Sp(200 MHz) < 800 sfu. Examples of each of these

three spectral types are given. 15 percent of the events could not be classified because of incomplete data.

23237 **(AD-A—187084/9/XAB) Coronal heating by means of helical magnetohydrodynamic turbulence. Memorandum report.** Dahlburg, R.B.; Dahlburg, J.P.; Mariska, J.T. (Naval Research Lab., Washington, DC (USA)). 17 Dec 1987. 43p. (NRL-MR—6073). NTIS, PC A03/MF A01.

Numerical simulations are used to investigate the relaxation of an unconfined, helically turbulent, fully three-dimensional magnetofluid, with conditions similar to those which are thought to result in the heating of the solar corona. In these simulations, the system evolves through a succession of force free states. After a relatively quiescent period of Ohmic decay, a phase of accelerated magnetic energy dissipation occurs. Some magnetic energy is transformed into kinetic energy, and the magnitude of entrophy created is a nontrival fraction of the mean square electric current. Concentrated vorticity structures are seen to play almost as important a role as electric current sheets in the heating process. Coincident with this accelerated dissipation process, a reorganization of the magnetic fields occurs, with transfer of magnetic energy to both shorter- and longer-wavelength modes than are initially present. The ratio of the magnetic field to the electric current density, alpha does not in general tend to assume a constant value in the force-free regions during the evolution of the magnetofluid.

23238 **(AD-A—187102/9/XAB) Cosmic-ray latitude surveys in the Atlantic Ocean area.** Shea, M.A.; Smart, D.F.; Stozhkov, Y.I.; Svirzhevsky, N.S.; Svirzhevskaya, A.K. (Air Force Geophysics Lab., Hanscom AFB, MA (USA)). 1987. 4p. (AFGL-TR—87-0292). NTIS, PC A02/MF A01.

Pub. in International Cosmic Ray Conference (20th), Vol. 4, 201-203(1987).

Vertical cutoff rigidities were re-determined for the locations of the stratospheric balloon measurements made during the 22nd Soviet Antarctic Expedition (1975-1976). These cutoff rigidities were determined for the month of each measurement using a method that interpolates between the world grids of trajectory-derived vertical cutoff rigidities calculated for Epoch 1965.0 and Epoch 1980.0. In comparing these values with other calculated using the 1975.0 field models which under-estimated the secular variations, small increases in the vertical cutoff rigidities were noted in the North Atlantic area and small decreases were noted in the South Atlantic, consistent with the secular changes in the world grid of vertical cutoff rigidities. These results emphasize the necessity of determining cutoff rigidity values of the year in which latitude measurements are made if these measurements are in the region of the world (particularly the Atlantic Ocean area) where the cutoff-rigidity values are rapidly changing.

23239 **(AD-A—187484/1/XAB) Vertical cutoff rigidities calculated using the estimated 1985 geomagnetic-field coefficients.** Smart, D.F.; Shea, M.A.; Gentile, L.C. (Air Force Geophysics Lab., Hanscom AFB, MA (USA)). 1987. 5p. (AFGL-TR—87-0285). NTIS, PC A02/MF A01.

Pub. in International Cosmic Ray Conference (20th), Conference Papers, Vol. 4, 204-207(1987).

Vertical cutoff rigidities were calculated for selected locations using geomagnetic-field coefficients appropriate for Epoch 1985.0. These coefficients were determined from the International Geomagnetic Reference Field for Epoch 1980.0 with the secular variations applied in the forward direction for a five-year time interval. The general trend of the vertical cutoff rigidities were calculated for previous epochs; the cutoff rigidity continues to decrease in the South Atlantic, Central, and South American regions and continues to increase in the North Atlantic. These results show the necessity of utilizing the appropriate geomagnetic field model to determine cutoff rigidities for latitude surveys that are conducted in these regions - particularly for those surveys conducted during solar minimum.

23240 **(AD-A—187485/8/XAB) Unusual aspects of the ground-level cosmic-ray event of 7-8 December 1982.** Smart, D.F.; Shea, M.A.; Flueckiger, E.O. (Air Force Geophysics Lab., Hanscom AFB, MA (USA)). 1987. 5p. (AFGL-TR—87-0286). NTIS, PC A02/MF A01.

Pub. in International Cosmic Ray Conference (20th), Conference Papers, Vol. 3, 135-138(1987).

The ground-level cosmic-ray event beginning about 2357 UT on 7 December 1982 had several unusual aspects. This event occurred while a geomagnetic storm was in progress. During this ground-level event the average observed direction of the interplanetary magnetic field vector near the earth was about 60 degrees (in GSE coordinates) east of the earth-sun line. The observations of this event by the world-side network of neutron monitors indicate a two-phase structure. The first phase was initiated by an impulsive increase suggesting a coherent flux of particles propagating along the interplanetary magnetic field generating an impulsive increase observable by neutron monitors viewing this anisotropic particle flux through each monitor's asymptotic cone of acceptance. During the second phase (well established about 30 minutes after the initial impulsive increase) the response of the world-wide neutron monitor network is consistent with a bidirectional anisotropy in the relativistic solar-particle flux moving along the interplanetary magnetic field having a relatively wide pitch angle distribution with a reverse flux of about 25% of the average forward flux.

23241 **(CEA-CONF—9160) Recent advances and future prospects in cosmic rays research.** Goret, P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Inst. de Recherche Fondamentale (IRF)). Aug 1987. 13p. (CONF-8708214—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88752140/JAW.

From 10. European cosmic ray symposium; Bordeaux, France (25 Aug 1987).

In the present paper we focus on some recent observations which led to improved understanding of some aspects of the GCR puzzle. These data essentially concern heavy ($Z=4$-30) and ultra-heavy ($Z>30$) nuclei in the energy range 0.1-20 GeV/nucleon. As we do not intend to cover the entire scope of cosmic rays studies, important matters such as antiprotons and positrons energy spectra, isotopic anomalies, high energy composition .. are not addressed. Finally a tentative overview of future prospects in cosmic rays research is presented.

23242 **(DOE/ER/40012—7) Nucleon decay, neutrino oscillations and super high energy particles: Progress report, February 1, 1987-January 31, 1988.** Lande, K. (Pennsylvania Univ., Philadelphia (USA)). Dec 1987. Contract AC02-81ER40012. 12p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005969/JAW.

This paper discusses the scintillation hodoscope and air shower array, the search for cosmic ray point sources, cosmic ray composition measurements, underground muon multiplicity and decoherence distributions and massive slow magnetic monopoles. 6 figs. (LSP)

23243 (INIS-BR—917, pp 12) **Atmospheric showers detection using Cerenkov radiation.** Brito, A.A.S.; Luksys, M.; Santos, I.R.S. 1987. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701458/JAW. (CONF-8709236—).

From 8. national meeting of particle physics and fields; Caxambu, MG, Brazil (16 Sep 1987).

23244 (INIS-BR—917, pp 13) **Gamma ray astronomy with a telescope using the 'Codified Mask' technique.** Bui-Van, N.A. (Universidade Estadual de Campinas, Brazil. Inst. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701458/JAW. (CONF-8709236—).

From 8. national meeting of particle physics and fields; Caxambu, MG, Brazil (16 Sep 1987).

23245 (INIS-BR—917, pp 20) **Inhomogeneous magnetic universes with a two fluid mixture.** Lima, J.A.S. de; Nobre, M.A.S. (Rio de Janeiro Univ., Brazil. Inst. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701458/JAW. (CONF-8709236—).

From 8. national meeting of particle physics and fields; Caxambu, MG, Brazil (16 Sep 1987).

23246 (INIS-BR—917, pp 21) **Bifurcation phenomena in the Brans-Dicke cosmology.** Romero, C. (Paraiba Univ., Joao Pessoa, Brazil). 1987. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701458/JAW. (CONF-8709236—).

From 8. national meeting of particle physics and fields; Caxambu, MG, Brazil (16 Sep 1987).

23247 (INIS-BR—917, pp 21) **On quantum cosmological singularities.** Lemos, N.A. (Universidade Federal Fluminense, Niteroi, Brazil). 1987. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701458/JAW. (CONF-8709236—).

From 8. national meeting of particle physics and fields; Caxambu, MG, Brazil (16 Sep 1987).

23248 (INIS-BR—917, pp 21) **Entropy variation of the cosmic background radiation in Friedmann models.** Lima, J.A.S. de; Waga, I. (Rio de Janeiro Univ., Brazil. Inst. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701458/JAW. (CONF-8709236—).

From 8. national meeting of particle physics and fields; Caxambu, MG, Brazil (16 Sep 1987).

23249 (INIS-BR—917, pp 21) **Anisotropic Eddington - Lemaitre phases in primitive universes.** Oliveira, A.L.; Mondaini, R.P. (Rio de Janeiro Univ., Brazil). 1987. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701458/JAW. (CONF-8709236—).

From 8. national meeting of particle physics and fields; Caxambu, MG, Brazil (16 Sep 1987).

23250 (INIS-BR—917, pp 22) **Several fluids structure for SO(N) scalar fields.** Nascimento, P.C.; Mondaini, R.P. (Lisboa Univ., Portugal; Rio de Janeiro Univ., Brazil). 1987. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701458/JAW. (CONF-8709236—).

From 8. national meeting of particle physics and fields; Caxambu, MG, Brazil (16 Sep 1987).

23251 (INIS-BR—917, pp 22) **Asymmetrical inflationary universes regulated by volume viscosity.** Portugal, R.; Lima, J.A.S. de; Waga, I. (Rio de Janeiro Univ., Brazil. Inst. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701458/JAW. (CONF-8709236—).

From 8. national meeting of particle physics and fields; Caxambu, MG, Brazil (16 Sep 1987).

23252 (INIS-BR—917, pp 23) **Inohomogeneous models with a two fluid mixture.** Lima, J.A.S. de; Tiomno, J. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1987. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701458/JAW. (CONF-8709236—).

From 8. national meeting of particle physics and fields; Caxambu, MG, Brazil (16 Sep 1987).

23253 (INIS-BR—917, pp 23) **Generalized inflation at constant temperature.** Portugal, R.; Lima, J.A.S. de; Waga, I. (Universidade Federal Fluminense, Niteroi, Brazil; Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro; Rio de Janeiro Univ., Brazil). 1987. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701458/JAW. (CONF-8709236—).

From 8. national meeting of particle physics and fields; Caxambu, MG, Brazil (16 Sep 1987).

23254 **(INIS-mf—11116) Infrared studies of asymptotic giant branch stars.** Willems, F.J. (Amsterdam Univ. (Netherlands)). 18 Mar 1987. 186p. NTIS (US Sales Only), PC A09/MF A01. Order Number TI88701751/JAW.

Includes summary in Dutch and previously published material.

In this thesis studies are presented of asymptotic giant branch stars, which are thought to be an important link in the evolution of the galaxy. The studies were performed on the basis of data collected by the IRAS, the infrared astronomical satelite. 233 refs.; 33 figs.; 16 tabs.

23255 **(INIS-mf—11117) Multiwavelength study of superoutbursts in dwarf novae.** Woerd, H.J. van der. (Amsterdam Univ. (Netherlands)). 21 Jan 1987. 191p. NTIS (US Sales Only), PC A09/MF A01. Order Number TI88701752/JAW.

Includes summary in Dutch and previously published material.

Dwarf novae are stellar systems consisting of two stars which orbit around each other within a few hours. In dwarf novae one of the stars, which is a bit smaller and less massive than our sun, loses matter to a very compact and degenerated star: a white dwarf. This white dwarf has nearly the same mass as our sun but its radius is about a hundred times smaller. The process of mass transport was studied on the basis of observations with the Exosat-satelite (European X-ray Observatory satelite). 397 refs.; 50 figs.; 21 tabs.

23256 **(ITEF—177(1986)) To the opportunities of cluster analysis of light curves of supernovae.** Bartunov, O.S.; Tsvetkov, D.Yu.; Morozov, Yu.I. (Moskovskij Gosudarstvennyj Univ. (USSR). Gosudarstvennyj Astronomicheskij Inst. "GAISh"; Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1986. 21p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701642/JAW.

A new approach to analysis of empirical data about supernova (SN), based on method of cluster analysis, is offered. One of the variants - a method of "nearest neighbour", is briefly described. The effectiveness of this method, applied to a problem of classification of 44 light curves of SN in a B-filter, and 22 curves in a V-filter, are demonstrated. This area of opportunities of this approach is briefly outlined. 22 ref.; 7figs.

23257 (JINR—R-7-86-322, pp 23) **Search for heavy and superheavy cosmic nucleus tracks in olivine from meteorites.** Perelygin, V.P.; Stetsenko, S.G.; Flerov, G.N. 1986. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780065/JAW.

In Heavy ion physics - 1985. Collection of annotations of the Nuclear Reaction Laboratory of the Joint Nuclear Research Institute works, 1985.

23258 (JINR—R-7-86-322, pp 22) **On the detection of rare nuclear transformations by multiple neutron events.** Flerov, G.N.; Ter-Akop'yan, G.M.; Sokol, E.A.; Sharo, Sh.; Zejnalov, Sh.S.; Ivanov, M.P. 1986. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780065/JAW.

In Heavy ion physics - 1985. Collection of annotations of the Nuclear Reaction Laboratory of the Joint Nuclear Research Institute works, 1985.

23259 (N—88-14502, pp vp) **Dynamics of meteor streams.** Babadjanov, P.B.; Obrubov, YU.U. Aug 1987. NTIS, PC A19/MF A01; also available from SCOSTEP Secretariat, Illinois Univ., 1406 West Green Street, Urbana, Ill. 61801. (NASA-CR—181571; NAS—1.26:181571; MAP-HANDBK—25; CONF-8508259—).

From 1. GLOBMET symposium on middle atmosphere program; Dushanbe, USSR (19 Aug 1985).

The overwhelming majority of meteor streams are generally assumed to be formed due to the decay of comets. The most effective process of the release of solid particles from a cometary nucleus is their ejection by sublimating gases when the comet approaches the Sun. The results of investigation of the Geminids and Quadrantids meteor stream evolution show that under the influence of planetary perturbations, the stream may originally be flat but then

thicken depending on the variation range of orbital inclinations. Eventually, due to planetary perturbations, a meteor stream may take such a shape as to cause the start of several active showers at different solar longitudes.

23260 (N—88-14502, pp vp) **Elementary process and meteor train spectra.** Ovezgeldyev, O.G. Aug 1987. NTIS, PC A19/MF A01; also available from SCOSTEP Secretariat, Illinois Univ., 1406 West Green Street, Urbana, Ill. 61801. (NASA-CR—181571; NAS—1.26:181571; MAP-HANDBK—25; CONF-8508259—).

From 1. GLOBMET symposium on middle atmosphere program; Dushanbe, USSR (19 Aug 1985).

Mechanisms of excitation of individual spectral line radiation were studied experimentally and theoretically and it was demonstrated that such processes as oxidation, resonant charge exchange, dissociative recombination and others play an important part in the chemistry of excited particles. The foundation was laid toward simulating the elementary processes of meteor physics. Having a number of advantages and possibilities, this method is sure to find a wide use in the future.

23261 (N—88-14502, pp vp) **Meteor observation by the Kyoto meteor radar.** Kato, S.; Tsuda, T. Aug 1987. NTIS, PC A19/MF A01; also available from SCOSTEP Secretariat, Illinois Univ., 1406 West Green Street, Urbana, Ill. 61801. (NASA-CR—181571; NAS—1.26:181571; MAP-HANDBK—25; CONF-8508259—).

From 1. GLOBMET symposium on middle atmosphere program; Dushanbe, USSR (19 Aug 1985).

The Kyoto Meteor Radar is a monostatic coherent pulsed Doppler radar operating on the frequency of 31.57 MH. The system is computer controlled and uses radio interferometry for echo height determination. The antenna, an improvement, can be directed either to the north or the east. The system has been continuously collecting data on winds at meteor heights by radar observation. The meteor echo rate was also measured, the echo rate distribution with height and the daily variation in height integrated echo rate are discussed. Investigations of atmospheric tides are being pursued by cooperative observations. A novel approach to the study of gravity waves was attempted using the meteor radar which is able to detect the horizontal propagation of the waves by observing the changing phase through the region illuminated by the radar.

23262 (N—88-14502, pp vp) **Possible origin of meteoroid generating asteroid orbits.** Kazantsev, A.M.; Sherbaum, L.M. Aug 1987. NTIS, PC A19/MF A01; also available from SCOSTEP Secretariat, Illinois Univ., 1406 West Green Street, Urbana, Ill. 61801. (NASA-CR—181571; NAS—1.26:181571; MAP-HANDBK—25; CONF-8508259—).

From 1. GLOBMET symposium on middle atmosphere program; Dushanbe, USSR (19 Aug 1985).

A mechanism to replenish the Apollo and Amor groups by resonant asteroid-orbit transformation is suggested. The method of this mechanism and the results obtained are discussed.

23263 (N—88-14855, pp 14) **Analysis of laser extracted volatiles in carbonaceous chondrites.** Blanford, G.E. Nov 1987. NTIS, PC A15/MF A01. (NASA-CR—172009-VOL-1; NAS—1.26:172009-VOL-1).

In National Aeronautics and Space Administration (NASA)/ American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1987. Volume 1.

It is scientifically important to understand the composition of volatile compounds from interplanetary dust particles (IDPs) because they may be related to the primordial inventory of planetary materials which were necessary to provide environments conducive to the formation of life. The use of a laser microprobe to measure volatiles in IDPs was evaluated. Because primitive meteorites are thought to be closely related to IDPs, carbonaceous chondrites were used for the evaluation. Three sets of experiments were performed to determine the volatiles released from potential substrate materials, to analyze the volatiles released from matrices of bulk samples of carbonaceous chondrites, and to analyze volatiles released from approx. 100 to 200 micron meteorite particles to simulate IDPs. Aluminum appeared to be the best choice of substrate material. Mass ratios between carbonaceous chondrite matrices of Allende and Murchison show fair reproducibility with somewhat high uncertainties. Particles from the Orgueil, Murchison, and Allende meteorites produced measurable quantities of volatiles that appear to have mass spectra comparable to the bulk matrices.

23264 (N—88-14874, pp vp) **Distribution of evaporitic weathering products on Antarctic meteorites.** Velbel, M.A. Nov 1987. NTIS, PC A15/MF A01. (NASA-CR—172009-VOL-2; NAS—1.26:172009-VOL-2).

In National Aeronautics and Space Administration (NASA)/ American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1987. Volume 2.

White evaporite deposits of terrestrial origin occur on some 5 percent of Antarctic meteorites. The few previous studies, and new mineralogical analyses, indicate that the deposits are predominately carbonates and/or sulfates of magnesium. The distribution of white evaporitic salt deposits differs among different meteorite compositional groups and weathering categories. Salts occur with unusual frequency on carbonaceous chondrites, and are especially common in carbonaceous chondrites of weathering categories A and B. Among achondrites, weathering categories A and A/B show the most examples of salt weathering. Unlike carbonaceous chondrites and achrondites, most salt-bearing ordinary (H and L) chondrites are from rustier meteorites of weathering categories B, and to a lesser degree, B/C and C. The LL chondrites are conspicuous by their complete lack or any salt-weathering product. Almost two-thirds of all evaporite-bearing meteorites belong to weathering categories, A, A/B, and B. Where chemical and/or mineralogical data are available, there is a persistent suggestion that evaporite formation is accompanied by elemental redistribution from meteorite interiors. Meteorites of weathering categories B, A/B, and even A may have experienced significant element redistribution and/or contamination as a result of terrestrial exposure.

23265 (N—88-14905) **EXOSAT guest observer program. Binary parameters of the x-ray pulsar 4U1626-67. Final report, 1 December 1986-30 November 1987.** Mcclintock, J.E. (Smithsonian Astrophysical Observatory, Cambridge, MA (USA)). Dec 1987. 33p. (NASA-CR—182374; NAS—1.26:182374). NTIS, PC A03/MF A01.

The pulsing x-ray source 4U1626-67 is an accreting neutron star in a binary system with a very low mass companion. The source was observed with EXOSAT continuously for 23 hr on 30 to 31 March 1986 UT. These observations allowed the setting of a stringent upper limit on the projected semimajor axis of the orbit of the neutron star of approx. 10 light msec for the 2485-s orbital period found by Middleditch et al., and a limit of approx. 13 light msec for any other plausible orbital period. The corresponding upper limit on the mass function for the 2485-s orbital period is 1.3 x 0.000001 solar mass. It was concluded that if the orbital inclination angle, i, equals 90 deg, then the optical companion star has a mass greater than 0.02 solar mass. However, it was found that a companion star mass greater than 0.06 solar mass is required if gravitational radiation is responsible for driving the mass transfer in this system. Only for i less than 16 deg can a companion star mass this large be accommodated by the limits set on the orbital amplitude. Also presented are results on the flaring activity in 4U1626-67 on time scales of approx. 1000 s, the energy dependent pulse profiles, and the pulse period history over the past decade.

23266 (N—88-14908) **Jupiter data analysis program (JDAP) research grant on wave accessibility and attributes. Final report.** Calvert, W. (Iowa Univ., Iowa City (USA)). 1987. 109p. (NASA-CR—182348; NAS—1.26:182348). NTIS, PC A06/MF A01.

For more than thirty years the intense decametric radio emissions from Jupiter (DAM) and the corresponding auroral kilometric radiation from the Earth (AKR) have remained major radio science mysteries. Part of the problem, aside from their inherent complexity, has been the difficulty of measuring their source location and emission properties from limited observations. Progress has been made on this problem by locating the source directly, i.e., by analysis of the faraday rotation observed with Voyager as the wave path crossed the Io plasma torus, and indirectly by comparing the peak frequencies of the decametric emission with that at the foot of

the Io flux tube. Progress was also made on the general question of how the emissions originate by finding properties of both the AKR and DAM which would imply emission by natural radio lasing.

23267 **(N—88-14911) Solar dynamics and G-modes. Final report.** Blizard, J.B. (Colorado Univ., Boulder, (USA). Cooperative Inst. for Research in Environmental Sciences). Feb 1987. 32p. (NASA-CR—180737; NAS—1.26:180737). NTIS, PC A03/MF A01.

Various properties of r-modes that would occupy the solar convection zone were computed. Values were calculated for the energy loss from the coefficient of eddy viscosity using the solar convective zone model. Viscous damping is strong and removes one-third or more of the mode energy each oscillation period. A fast Fourier transform (FFT) of daily Zurich sunspot number was made for eight sets of data, taken near peaks of solar cycles 14 to 21. The FFTs were evaluated with the Wolff and Hickey model. The horizontal component of F sub h of the force exerted by a planetary torque was calculated to see is it works on the photospheric layers at a rate comparable to 0.000001 solar luminosity. The time span of torque in the external sector of the Sun was calculated. The duration of the effect of two planets in conjunction on sunspot numbers was examined. The north-south asymmetry of solar activity was investigated.

23268 **(N—88-14919) Max '91: flare research at the next solar maximum.** Dennis, B.; Canfield, R.; Bruner, M.; Emslie, G.; Hildner, E.; Hudson, H.; Hurford, G.; Lin, R.; Novick, R.; Tarbell, T. (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center). Jan 1988. 42p. (NASA-TM—89700; NAS—1.15:89700). NTIS, PC A03/MF A01.

Original contains color illustrations.

To address the central scientific questions surrounding solar flares, coordinated observations of electromagnetic radiation and energetic particles must be made from spacecraft, balloons, rockets, and ground-based observatories. A program to enhance capabilities in these areas in preparation for the next solar maximum in 1991 is recommended. The major scientific issues are described, and required observations and coordination of observations and analyses are detailed. A program plan and conceptual budgets are provided.

23269 **(PB—88-138060/XAB) Solar-Geophysical Data Number 518, October 1987. Part 2 (comprehensive reports). Data for April 1987.** Coffey, H.E.; McKinnon, J.A. (National Geophysical Data Center, Boulder, CO (USA)). Oct 1987. 51p. (SGD—518-PT-2). NTIS, PC A04/MF A01.

See also PB—88-138078 and PB—88-128434.

Contents include: Detailed index for 1987; Data for September 1987; Data for August 1987; Pioneer XII Interplanetary magnetic field magnitudes May 87 neutron monitor climax Jul 87; Charts of Kiel/Tokyo Dec 86-Mar 87 sudden commencements/solar flare effects Jul 87 calcium-plage regions Feb 87; Daily maps Mar 87; Detailed Index for 1987; Data for April 1987; ERRATA: Solar radio data Nov 86.

23270 **(PB—88-138078/XAB) Solar-Geophysical Data Number 518, October 1987. Part 1 (prompt reports). Data for September 1987, August 1987, and late data.** Coffey, H.E.; McKinnon, J.A. (National Geophysical Data Center, Boulder, CO (USA)). Oct 1987. 113p. (SGD—518-PT-1). NTIS, PC A06/MF A01.

See also PB—88-138060 and PB—88-128426.

Contents include: Part 1 (Prompt reports) Detailed index for 1987; Data for September 1987; Data for August 1987; Pioneer XII interplanetary magnetic field magnitudes May 87 neutron monitor climax Jul 87; charts of Kiel/Tokyo Dec 86-Mar 87 sudden commencements/solar flare effects Jul 87; calcium-plage regions Feb 87; daily maps Mar 87; Part 2 (Comprehensive reports); Detailed index for 1987; Data for April 1987; Miscellaneous data; (ERRATA: Solar radio data Nov 86).

23271 **(RRK—86-23) Hydrodynamical equations for spherical gravitational collapse in terms of a generalized theory of gravitation with higher derivatives.** Nariai, H. (Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics). Jun 1986. 13p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703027/JAW.

In similar to Misner and Sharp's formalism in general relativity for a spherical gravitational collapse, a formalism for the spherical gravitational collapse is presented on the basis of a generalized theory of gravitation in the sense of Utiyama-DeWitt (which was later extended by Parker's school and Zel'dovich's one). The resulted formalism is somewhat similar to that developed by me in 1972 based on the scalar-tensor theory of gravity.

23272 **(RRK—86-34) Generation and propagation of sound waves in a collapsing or anti-collapsing star with uniform density.** Nariai, H. (Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics). Sep 1986. 12p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703034/JAW.

In our Research Note (dated on December 10th, 1965), we have dealt with the generation and propagation of sound waves in a collapsing or anti-collapsing star with uniform density. It seems that its contents do not lose their physical meaning even at the present time. This is the reason why we reproduce the Research Note.

23273 **(RRK—86-35) Disturbances (even-parity and odd-parity waves) of Nariai's peculiar universe.** Nariai, H. (Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics). Sep 1986. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703035/JAW.

In the Research Note dated on December 25th, 1963, I worked out odd-parity waves of the Schwarzschild-de Sitter universe and even-parity waves of the de Sitter universe. After that, in the Research Note dated on January 14th, 1964, I worked out the disturbances (even-parity and odd-parity waves) of Nariai's peculiar universe. Since the latter Note would not lose its physical meaning even at the present epoch, I will reproduce its contents in due course.

23274 **(RRK—86-36) Density perturbations in a rotating universe.** Nariai, H. (Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics). Sep 1986. 13p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703036/JAW.

In the Research Note dated on April 24th (1970), I worked out density perturbations in a rotating universe on the basis of Newtonian cosmology. Its contents corresponds to those of Silk in the Goedel relativistic universe, but our Newtonian approach is rather comprehensive in such a way that it does not lose a physical meaning even at the present time. This is the reason why I reproduce the contents here.

23275 **(RRK—86-37) Geodesic bi-scalars in (n+1)-dimensional spacetimes.** Nariai, H. (Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics). Sep 1986. 8p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703037/JAW.

This is a sequel to the previous papers RRK 85 - 12 and 85 - 18 (1985), which dealt with the geodesic bi-scalars in a Robertson-Walker universe with flat 3-space and in an anisotropic homogeneous universe, respectively. In the present article, the results obtained before are extended to the case of a (n+1)-dimensional spacetime.

23276 **(UCRL—97797) Density fluctuations from the quark-hadron epoch and primordial nucleosynthesis.** Fuller, G.M.; Mathews, G.J.; Alcock, C.R. (Lawrence Livermore National Lab., CA (USA)). 1 Dec 1987. Contract W-7405-ENG-48. 29p. (CONF-870802—39). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005645/JAW.

From 194. American Chemical Society national meeting; New Orleans, LA, USA (30 Aug 1987).

We present a simple thermodynamic model of the quark-hadron transition in the early universe and use this model to esti-

mate how the size of isothermal baryon number fluctuations which emerge from this epoch depend on the temperature of the transition and other uncertain quantities of the underlying QCD physics. We calculate primordial nucleosynthesis in the presence of these fluctuations and find that $\Omega = 1$ in baryons is possible only if the measured abundances of ^{7}Li and ^{2}H reflect substantial destruction during the evolution of the galaxy. 29 refs., 7 figs.

23277 Deep dielectric charging effects due to high-energy electrons in earth's outer magnetosphere. Baker, D.N.; Belian, R.D.; Higbie, P.R.; Klebesadel, R.W.; Blake, J.B. (Los Alamos National Lab., NM, USA; Aerospace Corp., El Segundo, CA, USA. Space Sciences Lab.). *Journal of Electrostatics;* 20: No. 1, 3-19(Oct 1987). (CONF-8606353—).

From Aerospace environment at high altitudes and its implications for spacecraft charging and communications; The Hague, Netherlands (2 Jun 1986).

Many spacecraft operational problems in the earth's outer magnetosphere appear to be due to intense, transient radiation phenomena. Three types of naturally occurring, and highly variable, hostile particle radiation environments are encountered at, or near, the geostationary orbit: (1) High-energy protons due to solar flares; (2) energetic ions and electrons produced by magnetospheric substorms; and (3) very-high-energy electrons of uncertain origin. In this paper, particular emphasis is given to highly relativistic electrons (3-10 MeV). Electron fluxes and energy spectra are shown which were measured by two high-energy electron sensor systems at 6.6 R/sub E/ from 1979 through 1984. Large, persistent increases in this population were found to be relatively infrequent and sporadic in 1978-81 around solar maximum. During the approach to solar minimum (1981-present) it is observed that the highly relativistic electrons occur with a regular 27-day periodicity, and are well associated with the re-established solar wind stream structures. Through a superposed epoch analysis technique we show that an energetic electron enhancement typically rises on a 2- to 3-day time scale and decays on 3- to 4-day scale at essentially all energies above ca. 3 MeV. The analysis suggests that these electrons have a very deleterious influence on spacecraft systems due to deep dielectric charging and low-dose susceptibility effects.

23278 Astrophysical radiation hydrodynamics. Winkler, K.H.; Norman, M.L. Norwell, MA; Kluwer Academic Publishers (1986). 604p. Kluwer Academic Publishers, 101 Philip Drive, Norwell, MA 02061.

This offers seventeen papers devoted exclusively to the presentation, evaluation, and comprehensive discussion of numerical methods in nonrelativistic and relativistic hydrodynamics, radiative transfer, and radiation-coupled hydrodynamics. The unifying theme of the lectures is the successful application of these methods to challenging problems in astrophysics. The book is divided into three independent sections: "Gas Dynamics" presents the basic complementary computational approaches: finite difference, finite element, particle modal, spectral, and explicit nonlinearity methods. The lectures focus on differences in procedure as well as differences in flow properties that each is particularly suited for. Under the heading "Radiation Gas Dynamics," theory, context, methodology, and application of radiation hydrodynamics to astrophysics are brought together. The last section, "Relativistic Flows," examines methods for the evolution of space-times both with and without matter present. The complementary formulations of conservation laws versus characteristic equations are also presented, and relativistic gas dynamics in both flat and curved space-times are contrasted to the Newtonian behavior.

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REFER ALSO TO CITATION(S) 22566, 23239, 23262, 23269, 23270

23279 (AD-A—187026/0/XAB) Theory and observations of Alfven solitons in the finite-beta magnetospheric plasma. Patel, V.L.; Dasgupta, B. (Denver Univ., CO (USA). Dept. of Physics). 1987. 14p. NTIS, PC A03/MF A01.

Pub. in Physica, Vol. 27D, 387-398(1987).

A nonlinear Schroedinger equation which governs the nonlinear evolution of Alfven wave in a hot, two-fluid plasma, is derived by using a modified version of reductive perturbation theory. The effect of coupling with the density fluctuation is taken into account in the calculation of nonlinear frequency shift. The theory is applied to explain recent observations of the solitary Alfven waves in space plasma. For the observational analysis, an extensive search was conducted by analyzing magnetic-field data from geostationary satellites GOES 2, 3, and 5 in the earth's magnetosphere at 6.6 earth radii. In data covering a period of August 1979-January 1984, we have found occurrence of 292 solitary wave events. Out of these events, 108 events are classified as Alfvenic solitons (perturbations perpendicular to the ambient field) and 184 mixed-mode solitons (perturbations perpendicular and parallel to the ambient field). No event for compressional mode solitons was found. It is believed, this is the first time such analysis and observations of solitary waves in space plasma have been performed. A statistical analysis has been carried out to compare the results of theory and observations. A range of unstable wave numbers was determined for the Alfvenic soliton in the magnetosphere.

23280 (AD-A—187051/8/XAB) Improvements in empirical modelling of the world-wide ionosphere. Final report, 30 September 1983-31 July 1986. Suchy, K.; Rawer, K. (Duesseldorf Univ. (Germany, F.R.). Inst. fuer Theoretische Physik). 31 Oct 1986. 119p. NTIS, PC A06/MF A01.

Using a method proposed by Booker, one can describe the ionospheric electron density profile in a fully analytical way by using Epstein - functions. Since the practical applications of this idea runs into serious difficulties, a solution to the encountered problems is presented. A combined function LAY is introduced which allows the particular peak condition to be automatically respected. A larger set of empirical profiles measured in W-Germany were analyzed and conclusions drawn how the function parameters could be determined for profile modeling. Numerical proposals are made with this in view. While these profiles are for the middle ionosphere, similar analysis is also executed for typical lower-ionosphere profiles and representative parameters are given.

23281 (AD-A—187055/9/XAB) High-frequency radiowave probing of the high-latitude ionosphere. Greenwald, R.A. (Johns Hopkins Univ., Laurel, MD (USA). Applied Physics Lab.). 1985. 14p. NTIS, PC A03/MF A01.

Pub. in John Hopkins APL Technical Digest, Vol. 6, No. 1, 38-50(1985); Original contains color plates: All DTIC/NTIS reproductions will be in black and white.

During the past several years, a program of high-frequency radiowave studies of the high-latitude ionosphere has been developed. Studies are now being conducted on the formation and motion of high-latitude ionospheric electron density irregularities, using a sophisticated high-frequency radar system installed at Goose Bay, Labrador. The radar antenna is also being used to receive signals from a beacon transmitter located at Thule, Greenland. This information is providing a better understanding of the spatial and temporal variability of high-latitude propagation channels and their relationship to disturbances in the magnetosphere/ionosphere system.

23282 (AD-A—187316/5/XAB) Hf phased-array radar for studying small-scale structure in the high-latitude ionosphere. Greenwald, R.A.; Baker, K.B.; Hutchins, R.A.; Hanuise, C. (Johns Hopkins Univ., Laurel, MD (USA). Applied Physics Lab.). Feb 1985. 20p. NTIS, PC A03/MF A01.

Pub. in Radio Science, Vol. 20, No. 1, 63-79(Jan-Feb 1985); Original contains color plates: All DTIC/NTIS reproductions will be in black and white.

Since October 1983, a new coherent backscatter radar has been in operation at Goose Bay, Labrador, for the purpose of studying small-scale electron density structure in the high-latitude ionosphere. This radar operates over a frequency band that extends from 8 to 20 MHz, and it uses an electronically phased array of 16 log-periodic antennas for both transmission and reception. The radar transmits a seven-pulse pattern that enables one to determine 17-lag complex autocorrelation functions of the backscattered signals as a function of range and azimuth. This paper presents a complete description of the radar including explanations of the operation of the phasing matrix, the techniques of data acquisition and analysis as implemented in the radar microcomputer, and the possible on-line and automatic operating modes that may be instituted.

Also presented are examples of some of the initial results obtained with the radar during the afternoon and late evening hours. These examples include images of the two-dimensional distribution of small-scale structure and of their associated mean Doppler motion. Examples of F-region Doppler spectra derived from the complex autocorrelation functions are also presented. These Doppler spectra show interesting differences from those of high-latitude E-region irregularities.

23283 (INIS-BR—917, pp 13) **Energetic eletrons measurements in atmosphere in the magnetic anomaly region at South Atlantic.** Martin, I.M.; Turtelli Junior, A.; Kurnosova, L.V.; Fradkin, M.I. (Universidade Estadual de Campinas, Brazil. Inst. de Fisica; Instituto Lebedev, Moscow, USSR). 1987. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701458/JAW. (CONF-8709236—).

From 8. national meeting of particle physics and fields; Caxambu, MG, Brazil (16 Sep 1987).

23284 (INIS-SU—442, pp 45-46) **On a possibility of separation of primary γ-quanta and charged particles on the Cherenkov component of extensive air showers by means of the Shalon type device at the altitude of 3340 m over the sea level.** Smirnov, A.Yu.; Morozov, A.E.; Pavlyuchenko, V.P. 1987. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88780052/JAW.

Kratkie soobshcheniya po fizike.; no. 4.

In Experimental and theoretical physics. Collection.

Calculation of spatial and angular distribution of Cherenkov radiation from extencive air showers (EAS) at primary energy of 1 TeV is carried out. It is shown that primary gamma-quanta may be separated from charged particles in a limited range of distances from the EAS axis using the SHALON type facilities.

23285 (INIS-SU—443/1, pp 39-41) **Effect of hadrons with an energy less 0.5 TeV on space-energy characterstics of the hadron component of extensive air showers detected by the Tayn'-Shan' device.** Dubovyj, A.G.; Morozov, A.E.; Nesterova, N.M.; Pavlyuchenko, V.P. 1987. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88780053/JAW.

Kratkie soobshcheniya po fizike.; no. 3.

In Experimental and theoretical physics. Collection.

Changes, introduced by 50-500 GeV hadrons into space-energy characteristics of the hadron component, detected by the Tyan'-Shan' device, are evaluated using model calculations of a nuclear-cascade process in the air from extensive air showers (EAS) of cosmic rays with the energy E/sub 0/=5x10/sup 14/-5x10/sup 15/ eV. Energy spectra and space distributions of hadrons in EAS, detected by the Tyan'-Shan' device (690 g cm/sup -2/ level), were compared in the preceding works to the results of calculation of nuclear-cascade process in the air. The calculations conducted show, that the account of 50-500 GeV hadrons role cannot change conclusions, related to peculiarities of hadron interaction with the air atomic nuclei at the energies of ≧ 10/sup 15/ eV, made on the basis of comparing the Tyan'-Shan' experimental data on the hadron component of the EAS to other calculations. 6 refs.

23286 (INIS-SU—443/1, pp 42-44) **Comparison with calculations of experimental data on Cherenkov radiation from extensive air showers at an energy of 10/sup 15/-10/sup 16/ eV at the mountain level.** Afanas'ev, B.N.; Nesterova, N.M.; Khejn, L.A. 1987. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88780053/JAW.

Kratkie soobshcheniya po fizike.; no. 3.

In Experimental and theoretical physics. Collection.

Data on measuring Cherenkov radiation at the level ~ 700 g x cm/sup -2/ in the extensive air showers (EAS) of cosmic particles with their energy exceeding 1 PeV are compared to results of calculating the nuclear-cascade process in the air under different assumptions concerning the growth with the energy of hadron interaction cross section. For 1-10 PeV EAS energies, experimental data on the Cherenkov radiation spatial distribution at the mountain level agree with the assumption, concerning a weaker growth of cross section of hadron interaction with the air atom nuclei, better than pp-interaction cross section growth at the energies of modern accelerators. 7 refs.

23287 (N—88-14502) **Middle atmosphere program. Handbook for MAP, volume 25.** Roper, R.G. (International Council of Scientific Unions). Aug 1987. 435p. (NASA-CR—181571; NAS—1.26:181571; MAP-HANDBK—25; CONF-8508259—). NTIS, PC A19/MF A01; also available from SCOSTEP Secretariat, Illinois Univ., 1406 West Green Street, Urbana, Ill. 61801.

From 1. GLOBMET symposium on middle atmosphere program; Dushanbe, USSR (19 Aug 1985).

GLOBMET (the Global Meteor Observation System) was first proposed by the Soviet Geophysical Committee and was accepted by the Middle Atmosphere Program Steering Committee in 1982. While the atmospheric dynamics data from the system are of primary interest to MAP, GLOBMET also encompasses the astronomical radio and optical observations of meteoroids, and the physics of their interaction with the Earth's atmosphere. These astronomical observations and interactional physics with the Earth's atmosphere are discussed in detail.

23288 (N—88-14502, pp vp) **Long-period variations of wind parameters in the mesopause region and the solar cycle dependence.** Greisiger, K.M.; Schminder, R.; Kuerschner, D. (Leipzig Univ., East Germany). Aug 1987. NTIS, PC A19/MF A01; also available from SCOSTEP Secretariat, Illinois Univ., 1406 West Green Street, Urbana, Ill. 61801. (NASA-CR—181571; NAS—1.26:181571; MAP-HANDBK—25; CONF-8508259—).

From 1. GLOBMET symposium on middle atmosphere program; Dushanbe, USSR (19 Aug 1985).

The solar cycle dependence of wind parameters below 100 km on the basis of long term continuous ionospheric drift measurements in the low frequency range is discussed. For the meridional prevailing wind no significant variation was found. The same comparison as for winter was done for summer where the previous investigations gave no correlation. Now the radar meteor wind measurement values, too, showed a significant negative correlation of the zonal prevailing wind with solar activity for the years 1976 to 1983. The ionospheric drift measurement results of Collm have the same tendency but a larger dispersion due to the lower accuracy of the harmonic analysis because of the shorter daily measuring interval in summer. Continuous wind observations in the upper mesopause region over more than 20 years revealed distinct long term variations, the origin of which cannot be explained with the present knowledge.

23289 (N—88-14502, pp vp) **Varintions of the semi-diurnal tidal wind in the meteor region with periods of about 27 and 13.5 days.** Greisiger, K.M. Aug 1987. NTIS, PC A19/MF A01; also available from SCOSTEP Secretariat, Illinois Univ., 1406 West Green Street, Urbana, Ill. 61801. (NASA-CR—181571; NAS—1.26:181571; MAP-HANDBK—25; CONF-8508259—).

From 1. GLOBMET symposium on middle atmosphere program; Dushanbe, USSR (19 Aug 1985).

Daily values of sunspot number and solar radio emission at 10.7 cm wavelength show a well known strong modulation with a period of 27 days, the Sun's rotation period. Recent satellite measurements revealed the same modulation of the ultraviolet irradiance at wavelength below 300 nm. These UV variations can influence the thermal heating of the ozone layer by altering the chemical composition. Therefore, one can also expect a corresponding variation in the middle atmosphere of the semi-diurnal tide, which is thermally excited essentially by absorption of UV between 200 and 370 nm in the upper ozone layer. Results of radar meteor wind measurements were used to detect a presumable very weak 27 day modulation within the natural and artificial noise of the daily values of the semi-diurnal wind amplitude. The summer period was chosen because of its relatively steady conditions and the maximum amplitudes during the year. The results of this investigation are given and discussed.

23290 (N—88-14502, pp vp) **Tidal activity in the meteor zone over Budrio, Italy.** Cevolani, G. Aug 1987. NTIS, PC A19/MF A01; also available from SCOSTEP Secretariat, Illinois Univ., 1406 West Green Street, Urbana, Ill. 61801. (NASA-CR—181571; NAS—1.26:181571; MAP-HANDBK—25; CONF-8508259—).

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A brief survey is presented of the variations with time and height of atmospheric tides observed at Budrio (45 deg N, 12 deg E) in the wind field between 80 and 110 km altitude during the 1978 to 1982 year period. Variations of amplitude maxima mainly of the semidiurnal tide in the winter data of 1979 and 1980 show periodicities of a few days throughout the observing period. Upward propagation of tidal energy during a stratospheric warming in January 1982 is proposed to be inhibited because of instabilities in atmospheric conditions.

23291 (N—88-14502, pp vp) **Internal gravity waves in the meteor zone in the Tbilisi Region.** Sharadze, Z.S.; Kikhvilashvili, G.B.; Liadze, Z.L.; Mosashvili, N.V. Aug 1987. NTIS, PC A19/MF A01; also available from SCOSTEP Secretariat, Illinois Univ., 1406 West Green Street, Urbana, Ill. 61801. (NASA-CR—181571; NAS—1.26:181571; MAP-HANDBK—25; CONF-8508259—).

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The study of wave disturbances (WD) in the upper part of the meteor zone (90 to 110 km) was made in the Tbilisi region. Observations were conducted using three ionospheric vertical sounders located at the corners of a triangle spaced from each other at a distance of 50 km, a four azimuth electrophotometer by the method of space reception with a small distance and a recording unit. These disturbances are measured and the results are given.

23292 (N—88-14502, pp vp) **Wave excitation in the turbulent meteor trace.** Jandieri, G.V.; Kevanishvili, G.SH.; Lenin, V.I. Aug 1987. NTIS, PC A19/MF A01; also available from SCOSTEP Secretariat, Illinois Univ., 1406 West Green Street, Urbana, Ill. 61801. (NASA-CR—181571; NAS—1.26:181571; MAP-HANDBK—25; CONF-8508259—).

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The solution to the problem of excitation of longitudinal and transverse electromagnetic waves in randomly inhomogeneous media is reduced to the derivation of a complex effective dielectric constant (EDC) tensor which nonlocally connects together the average macroscopic electromagnetic fields in continuous media, it is implied that the field values which are rapidly fluctuating on a microscopic scale in space and time become smoothed out in a specified way due to the inhomogeneous mixing of diffusion. Proceedings from the derived general expression for the EDC tensor new modes of longitudinal and transverse electromagnetic wave generation due to fluctuation in the parameters of the medium was predicted. In this connection, it is of interest to investigate the peculiarities of electromagnetic longitudinal and transverse wave propagation in such randomly inhomogeneous media where, apart from the charged particle concentration change, the random spatial and temporal changes of natural frequency of closely located oscillators take place.

23293 (N—88-14502, pp vp) **Methods and first results of plasma non-isothermal parameters measurements in meteor trails.** Kostylev, K.K.; Tokhtasjev, V.S. Aug 1987. NTIS, PC A19/MF A01; also available from SCOSTEP Secretariat, Illinois Univ., 1406 West Green Street, Urbana, Ill. 61801. (NASA-CR—181571; NAS—1.26:181571; MAP-HANDBK—25; CONF-8508259—).

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There is no reliable experimental evidence so far of either the presence or absence of nonisothermal effects in newly formed meteor trails. Neither is there a common opinion on the most effective mechanism of electron cooling. According to the laboratory experimental data collisions of atomic and molecular particles of all kinds having velocities of 10 to 70/kms often yields 1 eV electrons and not infrequently some have energies reaching several electron volts. These highest energy electrons are referred to as superhot electrons. The method of measurement and the results of these measurements in meteor trails are discussed.

23294 (N—88-14502, pp vp) **Meteor trail spectra.** Ovezgeldyev, O.G.; Mukhamednazarov, S.; Shafiev, R.I.; Maltsev, N.V. Aug 1987. NTIS, PC A19/MF A01; also available from SCOSTEP Secretariat, Illinois Univ., 1406 West Green Street, Urbana, Ill. 61801. (NASA-CR—181571; NAS—1.26:181571; MAP-HANDBK—25; CONF-8508259—).

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Meteor radiation appears as a result of collisions between meteoroid atoms and air molecules. Depending on duration, this radiation is usually divided into the following types: radiation of the meteor head; radiation of a coma surrounding or immediately following the meteor head; radiation of a trail formed as a result of fragments lagging behind or by the afterglow; and radiation of a meteor train forming from a tail as a result of various chemical and dynamical processes. To investigate physical processes caused by each of the above types, it is necessary to obtain the corresponding experimental data. The physical processes of the radiation and the measurement of the experimental data is discussed.

23295 (N—88-14502, pp vp) **End height of fireball as a function of their residual kinetic energy.** Revelle, D.O. Aug 1987. NTIS, PC A19/MF A01; also available from SCOSTEP Secretariat, Illinois Univ., 1406 West Green Street, Urbana, Ill. 61801. (NASA-CR—181571; NAS—1.26:181571; MAP-HANDBK—25; CONF-8508259—).

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Previous analyses of meteoroid compositional groupings have utilized the end height of fireballs as a diagnostic tool. From an observational perspective this definition is straight forward, but from a theoretical viewpoint there are problems with using this operational definition. In order to realistically assess the estimated geometric uncertainty of + 1 km in the observed end height, a theoretical definition of the end height of meteoritic fireballs is proposed using the results from the integral radiation efficiency model of ReVelle. Three photographed and recovered meteorites are used as a calibration for this proposed definition. This definition was used to evaluate the end height of all fireballs that were deduced by Wetherill and ReVelle as being meteoritic. In almost all cases the theoretical values are lower than the observed values, in some cases as much as 5 km lower. A preliminary summary of results are given.

23296 (N—88-14502, pp vp) **Meteor matter interaction with the Earth's atmosphere and the ionospheric E-region structure.** Alimov, O. Aug 1987. NTIS, PC A19/MF A01; also available from SCOSTEP Secretariat, Illinois Univ., 1406 West Green Street, Urbana, Ill. 61801. (NASA-CR—181571; NAS—1.26:181571; MAP-HANDBK—25; CONF-8508259—).

From 1. GLOBMET symposium on middle atmosphere program; Dushanbe, USSR (19 Aug 1985).

The exploration of the ionospheric E region is a pressing problem, both in the applied and fundamental studies. Results are presented of an investigation: (1) to estimate the meteor ionization contribution to the night time E layer and influx; (2) to study the phenomenon of intensive sporadic layer formation following cessation of meteor stream activity; and (3) to access the role of metallic ions of meteor origin in the diurnal and seasonal variations in the occurrence probabilities of midlatitude E/sub s/. The contribution was evaluated of meteor matter, Lyman radiation and corpuscular particles to the electron concentration of the night E region. Results are discussed.

23297 (N—88-14502, pp vp) **Processing method and results of meteor shower radar observations.** Belkovich, O.I.; Suleimanov, N.I.; Tokhtasjev, V.S. Aug 1987. NTIS, PC A19/MF A01; also available from SCOSTEP Secretariat, Illinois Univ., 1406 West Green Street, Urbana, Ill. 61801. (NASA-CR—181571; NAS—1.26:181571; MAP-HANDBK—25; CONF-8508259—).

From 1. GLOBMET symposium on middle atmosphere program; Dushanbe, USSR (19 Aug 1985).

Studies of meteor showers permit the solving of some principal problems of meteor astronomy: to obtain the structure of a stream in cross section and along its orbits; to retrace the evolution of particle orbits of the stream taking into account gravitational and nongravitational forces and to discover the orbital elements of its parent body; to find out the total mass of solid particles ejected from the parent body taking into account physical and chemical evolution of meteor bodies; and to use meteor streams as natural probes for investigation of the average characteristics of the meteor complex in the solar system. A simple and effective method of determining the flux density and mass exponent parameter was worked out. This method and its results are discussed.

23298 (N—88-14502, pp vp) **Photographic fireball networks.** Ceplecha, Z. Aug 1987. NTIS, PC A19/MF A01; also available from SCOSTEP Secretariat, Illinois Univ., 1406 West Green Street, Urbana, Ill. 61801. (NASA-CR—181571; NAS—1.26:181571; MAP-HANDBK—25; CONF-8508259—).

From 1. GLOBMET symposium on middle atmosphere program; Dushanbe, USSR (19 Aug 1985).

Long term radar observations of any meteor shower yield good data for a study of the features of its cross section structure in detail. The hourly rates of meteor echoes represent usually the basic data from which shower characteristics are derived. Unfortunately, the hourly rate does not depend only on the activity of the shower in question but also on the position of the shower radiant, on the mutual radiant antenna position, and on the parameters of the radar system. It is known that the knowledge of the response function of the radar is necessary for good interpretation of the hourly echo counts. A method of long term radar shower data analysis is discussed along with preliminary results.

23299 (N—88-14502, pp vp) **Method of long-term radar shower data analysis.** Simek, M. Aug 1987. NTIS, PC A19/MF A01; also available from SCOSTEP Secretariat, Illinois Univ., 1406 West Green Street, Urbana, Ill. 61801. (NASA-CR—181571; NAS—1.26:181571; MAP-HANDBK—25; CONF-8508259—).

From 1. GLOBMET symposium on middle atmosphere program; Dushanbe, USSR (19 Aug 1985).

Complex photographic and radar meteor observations have been carried out since 1957. Using the available observational data, the density of incident flux of meteoroids was estimated over a wide mass range of 0.001 to 100 g. To avoid the influence of apparatus selectivity a special technique was applied. The application of this technique to the radar shower data analysis is discussed in detail.

23300 (N—88-14502, pp vp) **Incident meteoroid flux density.** Badadjanov, P.B.; Bibarsov, R.SH.; Getman, V.S.; Kolmakov, V.M. Aug 1987. NTIS, PC A19/MF A01; also available from SCOSTEP Secretariat, Illinois Univ., 1406 West Green Street, Urbana, Ill. 61801. (NASA-CR—181571; NAS—1.26:181571; MAP-HANDBK—25; CONF-8508259—).

From 1. GLOBMET symposium on middle atmosphere program; Dushanbe, USSR (19 Aug 1985).

Complex photographic and radar meteor observations were carried out. Using the available observational data, the density of incident flux of meteoroids was estimated over a wide mass range of 0.001 to 100 g. To avoid the influence of apparatus selectivity a special technique was applied. The main characteristics of this technique are given and discussed.

23301 (N—88-14502, pp vp) **Models of sporadic meteor body distributions.** Andreev, V.V.; Belkovich, O.I. Aug 1987. NTIS, PC A19/MF A01; also available from SCOSTEP Secretariat, Illinois Univ., 1406 West Green Street, Urbana, Ill. 61801. (NASA-CR—181571; NAS—1.26:181571; MAP-HANDBK—25; CONF-8508259—).

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The distribution of orbital elements and flux density over the celestial sphere are the most common forms of representation of the meteor body distribution in the vicinity of the Earth's orbit. The determination of flux density distribution of sporadic meteor bodies was worked out. The method and its results are discussed.

23302 (N—88-14502, pp vp) **Meteor stream spatial structure theory.** Andreev, G.V. Aug 1987. NTIS, PC A19/MF A01; also available from SCOSTEP Secretariat, Illinois Univ., 1406 West Green Street, Urbana, Ill. 61801. (NASA-CR—181571; NAS—1.26:181571; MAP-HANDBK—25; CONF-8508259—).

From 1. GLOBMET symposium on middle atmosphere program; Dushanbe, USSR (19 Aug 1985).

The classical spatial representation of meteor streams is an elliptical torus with variable cross section. The position of this torus in space is determined by the mean orbit elements that may be obtained directly from observations of individual meteor stream particles when crossed by the Earth. Since the orbits of individual particles of a stream differ from each other, the distance between them on a plane normal to the mean orbit of elliptical torus forms some area, i.e., a cross section. The size and form of these cross sections change with the change of the direction among the mean orbit and are completely defined by the dispersion values of the orbit elements in a stream. An attempt was made to create an analytical method that would permit description of the spatial and time parameters of meteor streams, i.e., the form and size of their cross section, density of incident flux and their variations along the mean orbit and in time. In this case, the stream is considered as a continuous flux rather than a set of individual particles.

23303 (N—88-14502, pp vp) **Density variations of meteor flux along the Earth's orbit.** Svetashkova, N.T. Aug 1987. NTIS, PC A19/MF A01; also available from SCOSTEP Secretariat, Illinois Univ., 1406 West Green Street, Urbana, Ill. 61801. (NASA-CR—181571; NAS—1.26:181571; MAP-HANDBK—25; CONF-8508259—).

From 1. GLOBMET symposium on middle atmosphere program; Dushanbe, USSR (19 Aug 1985).

No model of distribution of meteor substance is known to explain the observed diurnal and annual variations of meteor rates, if that distribution is assumed to be constant during the year. Differences between the results of observations and the prediction of diurnal variation rates leads to the conclusion that the density of the orbits of meteor bodies changes with the motion of the Earth along its orbit. The distributions of the flux density over the celestial sphere are obtained by the method described previously by Svetashkova, 1984. The results indicate that the known seasonal and latitudinal variations of atmospheric conditions does not appear to significantly affect the value of the mean flux density of meteor bodies and the matter influx onto the Earth.

23304 (N—88-14502, pp vp) **Meteor velocity distribution and an optimum monitoring mathematical model.** Volkov, N.G.; Salimov, O.N. Aug 1987. NTIS, PC A19/MF A01; also available from SCOSTEP Secretariat, Illinois Univ., 1406 West Green Street, Urbana, Ill. 61801. (NASA-CR—181571; NAS—1.26:181571; MAP-HANDBK—25; CONF-8508259—).

From 1. GLOBMET symposium on middle atmosphere program; Dushanbe, USSR (19 Aug 1985).

At present, there are a great number of radio meteor, ionosphere and rocket observation data for the altitude range of 80 to 100 km which indicate the existence of large scale circulation systems in the mesopause to low thermosphere range which change regularly with season and latitude. But the existing observation network and observation programs are not optimal for revealing the main factors forming the circulation mode at these altitudes. A gen-

eralized optimum monitoring mathematical model is offered for consideration. The model input data are distribution density, response function, individual measurement root mean square uncertainty and detection effectiveness function. The model makes it possible to obtain the observation distribution density, the minimal possible dispersion and optimized system effectiveness.

23305 (N—88-14502, pp vp) **Valec fireball and predicted meteorite fall.** Ceplecha, Z.; Spurny, P. Aug 1987. NTIS, PC A19/MF A01; also available from SCOSTEP Secretariat, Illinois Univ., 1406 West Green Street, Urbana, Ill. 61801. (NASA-CR—181571; NAS—1.26:181571; MAP-HANDBK—25; CONF-8508259—).

From 1. GLOBMET symposium on middle atmosphere program; Dushanbe, USSR (19 Aug 1985).

A fireball was photographed with a luminous trajectory below a height of 20 km. On Aug. 3, 1984, seven stations photographed this slow-moving fireball, which traversed 94 km of luminous trajectory in 9.2 sec and terminated its visible flight at a height of 19.1 km. The computed dark flight trajectory intersected the surface close to Valec, a small village 40 km west of Brno. The Valec fireball was the lowest photographed fireball ever. The Valec fireball was photographed by fish eye cameras. The positional precision of all the records were within the range of 1 to 2 minutes of arc. All computations were done using the FIRBAL program, a set of almost 4000 Fortran statements run on EC 1040 computer. The average computed mass at the terminal point, i.e., the predicted mass of the biggest meteorite, was 16 kg. This number is based on the dynamical data at the terminal point solely. Visual data was also collected from occasional observers. This observed phenomenon is discussed.

23306 (N—88-14502, pp vp) **Results of observations of the Eta Aquarid and Orionid meteor showers in 1980-1984.** Hajduk, A. Aug 1987. NTIS, PC A19/MF A01; also available from SCOSTEP Secretariat, Illinois Univ., 1406 West Green Street, Urbana, Ill. 61801. (NASA-CR—181571; NAS—1.26:181571; MAP-HANDBK—25; CONF-8508259—).

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The main characteristics of meteor showers associated with Comet Halley were derived from the most recent radar observations carried out at the Ondrejov Astronomical Observatory during the periods of May 1 to 10 and October 15 to 30. The activity variations, the positions of activity maxima, the size distribution of particles, the particle flux variation within the stream and other characteristics were determined and compared with other results.

23307 (N—88-14502, pp vp) **Monte Carlo modeling and meteor showers.** Kulikova, N.V. Aug 1987. NTIS, PC A19/MF A01; also available from SCOSTEP Secretariat, Illinois Univ., 1406 West Green Street, Urbana, Ill. 61801. (NASA-CR—181571; NAS—1.26:181571; MAP-HANDBK—25; CONF-8508259—).

From 1. GLOBMET symposium on middle atmosphere program; Dushanbe, USSR (19 Aug 1985).

Prediction of short lived increases in the cosmic dust influx, the concentration in lower thermosphere of atoms and ions of meteor origin and the determination of the frequency of micrometeor impacts on spacecraft are all of scientific and practical interest and all require adequate models of meteor showers at an early stage of their existence. A Monte Carlo model of meteor matter ejection from a parent body at any point of space was worked out by other researchers. This scheme is described. According to the scheme, the formation of ten well known meteor streams was simulated and the possibility of genetic affinity of each of them with the most probable parent comet was analyzed. Some of the results are presented.

23308 (N—88-14502, pp vp) **Spatial structure of the Perseids meteor stream.** Andreev, G.V.; Rubtsov, L.N.; Tarasova, I.I. Aug 1987. NTIS, PC A19/MF A01; also available from SCOSTEP Secretariat, Illinois Univ., 1406 West Green Street, Urbana, Ill. 61801. (NASA-CR—181571; NAS—1.26:181571; MAP-HANDBK—25; CONF-8508259—).

From 1. GLOBMET symposium on middle atmosphere program; Dushanbe, USSR (19 Aug 1985).

The analysis of radar observations of the Perseid meteor stream conducted in an ionospherical laboratory in the period from 1964 to 1981 is presented. The Perseids meteor rates were determined by the fluctuation method. Analysis of their hourly distributions showed that the stream maximum position is different for different years, i.e., the stream nodal position is constantly changing. The results of the analysis are presented and discussed.

23309 (N—88-14502, pp vp) **Some models of the Geminids meteor stream formation.** Belkovich, O.I.; Ryabova, G.O. Aug 1987. NTIS, PC A19/MF A01; also available from SCOSTEP Secretariat, Illinois Univ., 1406 West Green Street, Urbana, Ill. 61801. (NASA-CR—181571; NAS—1.26:181571; MAP-HANDBK—25; CONF-8508259—).

From 1. GLOBMET symposium on middle atmosphere program; Dushanbe, USSR (19 Aug 1985).

Further development of methods of investigations of meteor shower structure and a great deal of observational data have made it possible to obtain a precise flux density profile along the Earth's orbit for the Geminids meteor shower. This curve proved to be adequately described by a exponential law. Examined are: (1) which ejection model will fit the observed shower structure; and (2) to what extent the subsequent process of evolution modifies the formed structure. The following conclusions are drawn: (1) When studying the mechanism of formation of meteor streams, it is necessary to take into consideration the velocity distribution of particles that have been ejected from the parent body; (2) On the basis of the observed density variations, it is possible to determine what kind of ejection takes place (a single ejection or that around an orbital arch); and (3) The original structure of the Geminids cross section persists for no more than 1500 to 2000 years.

23310 (N—88-14502, pp vp) **Structural peculiarities of the Quadrantid meteor shower.** Isamutdinov, SH.O.; Chebotarev, R.P. Aug 1987. NTIS, PC A19/MF A01; also available from SCOSTEP Secretariat, Illinois Univ., 1406 West Green Street, Urbana, Ill. 61801. (NASA-CR—181571; NAS—1.26:181571; MAP-HANDBK—25; CONF-8508259—).

From 1. GLOBMET symposium on middle atmosphere program; Dushanbe, USSR (19 Aug 1985).

Systematic radio observations to investigate the Quadrantid meteor shower structure are regularly carried out. They have now been conducted annually in the period of its maximum activity, January 1 to 6, since 1966. The latest results of these investigations are presented, on the basis of 1981 to 1984 data obtained using new equipment with a limiting sensitivity of +7.7/sup m/ which make it possible to draw some conclusions on the Quadrantids shower structure both for transverse and lengthwise directions.

23311 (N—88-14502, pp vp) **Meteor detection on ST (MST) radars.** Avery, S.K. Aug 1987. NTIS, PC A19/MF A01; also available from SCOSTEP Secretariat, Illinois Univ., 1406 West Green Street, Urbana, Ill. 61801. (NASA-CR—181571; NAS—1.26:181571; MAP-HANDBK—25; CONF-8508259—).

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The ability to detect radar echoes from backscatter due to turbulent irregularities of the radio refractive index in the clear atmosphere has lead to an increasing number of established mesosphere - stratosphere - troposphere (MST or ST) radars. Humidity and temperature variations are responsible for the echo in the troposphere and stratosphere and turbulence acting on electron density gradients provides the echo in the mesosphere. The MST radar and its smaller version, the ST radar, are pulsed Doppler radars operating in the VHF - UHF frequency range. These echoes can be used to determine upper atmosphere winds at little extra cost to the ST radar configuration. In addition, the meteor echoes can supplement mesospheric data from an MST radar. The detection techniques required on the ST radar for delineating meteor echo returns are described.

23312 (N—88-14502, pp vp) **New approaches to some methodological problems of meteor science.** Meisel, D.D. Aug 1987. NTIS, PC A19/MF A01; also available from SCOSTEP Secretariat, Illinois Univ., 1406 West Green Street, Urbana, Ill. 61801. (NASA-CR—181571; NAS—1.26:181571; MAP-HANDBK—25; CONF-8508259—).

From 1. GLOBMET symposium on middle atmosphere program; Dushanbe, USSR (19 Aug 1985).

Several low cost approaches to continuous radioscatter monitoring of the incoming meteor flux are described. Preliminary experiments were attempted using standard time frequency stations WWVH and CHU (on frequencies near 15 MHz) during nighttime hours. Around-the-clock monitoring using the international standard aeronautical beacon frequency of 75 MHz was also attempted. The techniques are simple and can be managed routinely by amateur astronomers with relatively little technical expertise. Time series analysis can now be performed using relatively inexpensive microcomputers. Several algorithmic approaches to the analysis of meteor rates are discussed. Methods of obtaining optimal filter predictions of future meteor flux are also discussed.

23313 (N—88-14502, pp vp) **Lidar investigations of M-zone.** Ovezgeldiyev, O.G.; Kurbanmuradov, K.; Lagutin, M.F.; Zarudny, A.A.; Meghel, YU.E.; Torba, A.A.; Melnikov, V.E. (Kharkovskii Institute Radioelektroniki, USSR). Aug 1987. NTIS, PC A19/MF A01; also available from SCOSTEP Secretariat, Illinois Univ., 1406 West Green Street, Urbana, Ill. 61801. (NASA-CR—181571; NAS—1.26:181571; MAP-HANDBK—25; CONF-8508259—).

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The creation of pulse dye lasers tuned to resonant line of meteor produced admixtures of atmospheric constituents has made it possible to begin lidar investigations of the vertical distribution of mesospheric sodium concentration and its dynamics in the upper atmosphere. The observed morning increase of sodium concentration in the vertical column is probably caused by diurnal variations of sporadic meteors. The study of the dynamics of the sodium column concentration in the period of meteor streams activity confirms the suggestion of cosmic origin of these atoms. The short lived increase of sodium concentration brought about by a meteor stream, however, exceeds by one order the level of the sporadic background.

23314 (N—88-14502, pp vp) **Optical electronics for meteor observations.** Shafiev, R.I.; Mukhamednazarov, S.; Atamas, I.A. Aug 1987. NTIS, PC A19/MF A01; also available from SCOSTEP Secretariat, Illinois Univ., 1406 West Green Street, Urbana, Ill. 61801. (NASA-CR—181571; NAS—1.26:181571; MAP-HANDBK—25; CONF-8508259—).

From 1. GLOBMET symposium on middle atmosphere program; Dushanbe, USSR (19 Aug 1985).

Spectral observations of meteors have been carried out for several years using an optical electronics facility. Interest has centered on faint meteors and their trails in the period of intensive meteor showers. Over 800 meteors were registered during the observation period, with spectrograms obtained for 170 of these. A total of 86 meteors were photographed from two sites and for 25 of these spectrograms of the meteors as well as their trails were obtained. All meteors have undergone routine processing in order to determine atmospheric characteristics. Results are discussed.

23315 (N—88-14855, pp vp) **Atmospheric entry heating of cosmic dust.** Flynn, G.J. Nov 1987. NTIS, PC A15/MF A01. (NASA-CR—172009-VOL-1; NAS—1.26:172009-VOL-1).

In National Aeronautics and Space Administration (NASA)/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1987. Volume 1.

A computer simulation of the atmospheric entry deceleration and heating for micrometeorites into a planetary atmosphere was developed. The results of this model were compared to an earlier model. The major difference between the extent of heating experienced in the two models results from an underestimation of the atmospheric density at altitudes above 130 km in the earlier model. Thus the earlier model systematically overestimates the peak temperature reached on atmospheric entry. The discrepancies are small for near vertical entry and/or high density particles, where little deceleration is experienced at high altitudes. For particles entering at grazing incidence and/or of low density the discrepancies are more pronounced. Gravitational enhancement, which is a function of geocentric velocity at the collection opportunity, was found to bias near Earth cosmic dust collections in favor of low velocity particles. The effect is to increase the proportion of low velocity dust, predominately from asteroids, in the stratospheric cosmic dust collections and on Earth orbiting spacecraft impact surfaces over its proportion in the interplanetary dust cloud.

23316 (PB—88-147897/XAB) **Auroral-electron acceleration by lower-hybrid waves.** Bingham, R.; Bryant, D.A.; Hall, D.S. (Rutherford Appleton Lab., Chilton (UK)). Sep 1987. 34p. (RAL—87-073). NTIS, PC E04/MF E04.

See also PB—86-173853.

The possibility that the electrons producing discrete aurora are stochastically accelerated by waves is investigated. It is demonstrated that the lower-hybrid waves seen on auroral field lines have the right properties to account for the electron acceleration. It is further shown that the lower-hybrid wave power measured on auroral field lines can be generated by the streaming ions observed at the boundary of the plasma sheet, and that this wave power is sufficient to account for the electron distributions observed close to the atmosphere.

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23317 (AD-A—186955/1/XAB) **Excitation of the 1s5 and 1s4 levels of neon by low-energy electrons.** Tachibana, K.; Phelps, A.V. (Joint Inst. for Lab. Astrophysics, Boulder, CO (USA)). 1 Aug 1987. 9p. NTIS, PC A02/MF A01.

Pub. in Physical Review A, Vol. 36, No. 3, 999-1007(1 Aug 1987).

Excitation coefficients for production of 1s4 levels (Paschen notation) of neon in collisions with low-energy electrons have been measured using drift tube technique combined with laser absorption and laser-induced fluorescence techniques. The absorption and fluorescence signals were analyzed using coupled rate equations which include the effects of population mixing among these levels in collisions with neon atoms. The excitation coefficients for the metastable and resonance levels alpha sub mv/N and alpha sub r/N were obtained as functions of the electric field to gas density ratio E/NM. The measured values of alpha m/N vary from $1.3X10^{-24}$ m2 at E/N = $1.6X10^{21}$ Vm^2 to $6.5X1-10^{22}$ m2 at $3.0X10^{19}$ V m^2. The values of alpha sub r/N are comparable in the experimental E/N range. The experimental excitation coefficients are in agreement with values calculated from a Boltzmann analysis using a recommended set of electron excitation cross sections derived from published experimental electron beam data.

23318 (AD-A—187203/5/XAB) **Sensitivity of atomic line shapes to the laser model.** Arnoldus, H.F.; George, T.F. (State Univ. of New York, Buffalo (USA)). 1987. 3p. NTIS, PC A02/MF A01.

Pub. in Spectral Line Shapes, Vol. 4, 569-570(1987).

For coherent excitation of an atom by a single-mode laser, it is found that the commonly applied Gaussian diffusion process can give a poor account of laser-linewidth effects at high intensities on the shape of spectral lines.

23319 (AD-A—187241/5/XAB) **Light absorption by an atom moving inside a spherical box. Technical report.** Last, I.; George, T.F. (State Univ. of New York, Albany (USA). Dept. of Chemistry). Sep 1987. 25p. (UBUFFALO/DC—87/TR-53). NTIS, PC A03/MF A01.

The radiative transition for an atom moving inside a spherical box is considered in the terms of electronic-field states. By using the hopping model, an analytical expression is obtained by numerical integration of the time-dependent Schrodinger equations.

23320 (AD-A—187461/9/XAB) Forces on neutral atoms due to electromagnetic fields. Annual summary report, 1 September 1986-31 August 1987. Pritchard, D.E. (Massachusetts Inst. of Tech., Cambridge (USA). Research Lab. of Electronics). Sep 1987. 5p. NTIS, PC A02/MF A01.

The construction of the superconducting magnetic trap was completed and, as a major breakthrough in the field, was used to trap approx. 10^9 of neutral sodium atoms for periods of several minutes. This represented an advance of several orders of magnitude compared to previous neutral-trapping experiments, both in numbers of trapped atoms, and in trapping times achieved. The continuous loading process pioneered in this experiment has represented an important advance over previous pulsed loading schemes, as it has permitted the accumulation of much larger numbers of atoms in the trap. The fluorescence spectra of the trapped atoms is studied using a weak-probe laser beam (I =(I sub sat/10,000), which does not affect the trapped atoms appreciably. Doppler cooling of the trapped atoms is studied using this spectrum to measure the temperature of the atomic sample. Observed, for the first time, is the effect of gravity on trapped atoms: the trapped atoms do not accumulate at the minimum of the magnetic field, but at the minimum of the total mechanical potential obtained when including the effect of gravity. RF resonance will be used to study the trapped atoms, and optical-RF cyclic cooling of the atoms will be used to attempt to achieve sample temperatures < or = .000001 K.

23321 (AD-A—187643/2/XAB) Charge exchange in low-energy (keV) and hyperthermal-energy (10-100eV) ion scattering. Final report, 1 April 1986-15 November 1987. Cooper, B.H. (Cornell Univ., Ithaca, NY (USA). Lab. of Atomic and Solid State Physics). 10 Dec 1987. 14p. NTIS, PC A03/MF A01.

The overall research program described in this report is to investigate the interaction of low (keV) and hyperthermal (10-100 eV) ions with clean and adsorbate-covered metal surfaces; in particular, ion-surface charge-exchange processes. We report on the operation of the UHV scattering apparatus for the ion-scattering measurements, ongoing development and upgrade of the apparatus, the use of two ion-scattering simulations which together cover the entire energy range of interest, the further development of these simulations, and most importantly, the ongoing experiments to determine charge-transfer probabilities. The data presented are representative of the scattering spectra measured. Completed analysis of these and similar spectra will be presented in forthcoming papers. To date, the authors have measured spectra for Li+, Na+, K+, He+, Ne+, and Ar+ beams, ranging in energy from 50 eV to 4 keV, scattered from the <001> and <1-10> azimuths of Cu(110). Important features of these spectra have been identified with the scattering simulations.

23322 (CBPF-NF—020/87) Softness of an atom in a molecule and a functional group softness definition; an LCAO scale. Giambiagi, M.; Giambiagi, M.S. de; Pires, J.M.; Pitanga, P. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1987. 22p. NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701540/JAW.

We introduce a scale for the softness of an atom in different molecules and we similarly define a functional group softness. These definitions, unlike previous ones, are not tied to the finite difference approximation neither, hence, to valence state ionization potentials and electron affinities; they result from the LCAO calculation itself. We conclude that a) the softness of an atom in a molecule shows wide variations; b) the geometric average of the softnesses of the atoms in the molecule gives the most consistent results for the molecular softnesses; c) the functional group softness is transferable within a homologous series.

23323 (CENBG—8708) Experimental and theoretical study in IWO Cenier electron emission in 25-MeV/u Mo/sup 40+/ + He collisions. Scheurer, J.N.; Andriamonje, S.; Bertault, D.; Chemin, J.F. (Bordeaux-1 Univ., 33 - Gradignan (France). Centre d'Etudes Nucleaires). Jul 1987. 1p. (CONF-870715—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88752118/JAW.

From 15. international conference on the physics of electronic and atomic collisions; Brighton, UK (22 Jul 1987).

23324 (CERN-EP—87-75) Antihydrogen formation through positron-antiproton radiative combination. Poth, H. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Kernphysik; European Organization for Nuclear Research, Geneva (Switzerland)). 10 Apr 1987. 11p. (CONF-8609387—1). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88900428/JAW.

From International symposium on the production of low-energy positrons with accelerators and applications; Giessen, F.R. Germany (25 Sep 1986).

In this paper the production of a beam of antihydrogen atoms through the capture of positrons by antiprotons in an arrangement of merged parallel beams is considered. The achievable luminosity is estimated on the basis of available antiproton and positron intensities. The scaling of the luminosity with various parameters is investigated. It is argued that an intense beam of antihydrogen can be obtained if antiprotons and positrons are stored, recirculated and cooled. While the number of stored antiprotons which can be achieved at present is already high, schemes for the accumulation of slow and cooled positrons have to be developed. Possible ways are pointed out. The fact that a high number of both species of charged particles can be accumulated, stored, and recirculated, compensates largely for the low capture cross-section. 31 refs.

23325 (CONF-880402—1) A multiphoton ionization technique for the determination of the ionization threshold of molecules in fluid media. Faidas, H.; Christophorou, L.G. (Tennessee Univ., Knoxville (USA); Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002691/JAW.

From CLEO '88: OSA/IEEE conference on lasers and electro-optics; Anaheim, CA, USA (25 Apr 1988).

A new laser-induced multiphoton conductivity technique for the determination of the ionization threshold of molecules in fluids (liquids and dense gases) is described. Results are presented and discussed on aromatic molecules in nonpolar fluids. 2 refs., 1 fig., 1 tab.

23326 (CONF-8708164—6) Doubly-excited levels in Al III. Martinson, I.; Curtis, L.J.; Haar, R.R.; Raphaelian, M.L.A.; Berry, H.G.; Kurtz, C. (Lund Univ. (Sweden). Dept. of Physics; Toledo Univ., OH (USA). Dept. of Physics and Astronomy; Argonne National Lab., IL (USA)). Aug 1987. Contract W-31109-ENG-38. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005928/JAW.

From International conference on spectroscopy and structure of highly ionized atoms; Lisle, IL, USA (17 Aug 1987).

We have used the beam-foil technique to search for transitions between the doubly-excited quarter levels in Al III. These levels, due to excitation of an inner-shell 2p electron, lead to radiation in the range of 900 to 1500 A. Calculations using a multi-configurational Dirac Fock code have enabled us to propose preliminary identification of a number of transitions in this wavelength region. 8 refs., 2 figs.

23327 (CONF-8711107—5) The Argonne PIIECR ion source project status. Pardo, R.C.; Billquist, P.J. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 14p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005983/JAW.

From International conference on ECR ion sources and their applications; East Lansing, MI, USA (16 Nov 1987).

The first beam from the Argonne PIIECR ion source was achieved on October 21, 1987. The major construction effort for both the source and high voltage platform is finished but a number of subsystems remain to be completed such as the remote control system and a gas handling system. Early source operation indicates that the major elements are functioning as designed, with the exception of the extraction high voltage insulation. Beam has been accelerated off the high voltage platform to a temporary atomic physics experimental area. The source is a major element in the ATLAS Positive Ion Injector project. 4 refs., 5 figs., 1 tab.

23328 **(CONF-8711107—6) Atomic physics at the Argonne PII ECR [electron cyclotron resonance] Ion Source.** Dunford, R.W.; Berry, H.G.; Billquist, P.J.; Pardo, R.C.; Zabransky, B.J.; Bakke, E.; Groeneveld, K.O.; Hass, M.; Raphaelian, M.L.A. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 13p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005995/JAW.

From International conference on ECR ion sources and their applications; East Lansing, MI, USA (16 Nov 1987).

An atomic physics beam line has been set up at the Argonne PII ECR Ion Source. The source is on a 350-kV high-voltage platform which is a unique feature of particular interest in work on atomic collisions. We describe our planned experimental program which includes: measurement of state-selective electron-capture cross sections, studies of doubly-excited states, precision spectroscopy of few-electron ions, tests of quantum electrodynamics, and studies of polarization transfer using optically pumped polarized alkali targets. The first experiments will be measurements of cross sections for electron capture into specific nl subshells in ion-atom collisions. Our method is to observe the characteristic radiation emitted after capture using a VUV spectrometer. Initial data from these experiments are presented. 12 refs., 4 figs.

23329 **(DOE/ER/13549—2) [Electron transfer, ionization, and excitation in atomic collisions]: Progress report.** (Pennsylvania State Univ., University Park (USA)). 1987. Contract FG02-86ER13549. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88006404/JAW.

The fundamental processes of electron transfer, ionization, and excitation in ion-atom collisions are being studied. These collision processes are treated in the context of simple one- or two-electron systems in order to provide unambiguous results and reveal more clearly the collisional mechanisms. As outlined in the original proposal, three coupled-state calculations are being carried out over the present three-year period: a Sturmian-pseudostate study of ionization in collisions between protons and the hydrogenic ions He^+, Li^{2+}, Be^{3+}, ...; a triple-center, atomic-state study of ionization in collisions between α particles and H(ls) atoms and between protons and He^+(ls) ions; and an atomic-state study of electron transfer and excitation in collisions between protons and neutral He atoms. 12 refs.

23330 **(DOE/ER/13630—2) Many-body processes in atomic and molecular physics: Progress report, September 1, 1986-August 31, 1988.** Chu, Shih-I. (Kansas Univ., Lawrence (USA). Dept. of Chemistry). Feb 1988. Contract FG02-86ER13630. 37p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006285/JAW.

This paper discusses the work being done at the University of Kansas in many-body processes in atomic and molecular physics. The particular topics discussed are: Complex-coordinate coupled-channel methods for autoionization predissociation and multiphoton resonances; intensity-dependent ionization potential and above-threshold multiphoton ionization; collisional processes in the presence of laser fields; Floquet-Liouville supermatrix approach to intense field multiphoton and nonlinear optical processes; and classical time-dependent self-consistent field approach to intense field multiphoton dissociation of molecules. 17 refs., 16 figs. (LSP)

23331 **(GSI—87-62(prepr.)) On the production mechanism of the narrow positron lines observed in heavy-ion collisions.** Tsertos, H.; Bosch, F.; Kienle, P.; Koenig, W.; Kozhuharov, C.; Berdermann, E.; Clemente, M.; Wagner, W. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Technische Univ. Muenchen, Garching (Germany, F.R.). Fakultaet fuer Physik). Oct 1987. 7p. Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.).

Following a suggestion of Bang et al. we deduce that the total energy transfer associated with the narrow positron lines observed in heavy-ion collisions is given approximately by the sum of the rest masses of the positron and the accompanied electron plus their kinetic energies. Since the same behaviour has been established previously for the production process of the dynamically induced positrons, our observation represents a strong hint that the origin of the e/sup +/-lines may also be connected with the strong Coulomb field occurring in heavy-ion collisions.

23332 **(IAE—4409/1) On universally of exponential variational expansion in Coulomb three-body problem.** Frolov, A.M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1987. 16p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701571/JAW.

Problem of precise determination of bound states of Coulomb three-body systems is considered in the paper. Exponential expansion is used. Results of calculations of a series of states of mesomolecules, exotic mesoatoms and helium atom with infinitely heavy nucleus (/sup ∞/He) are presented. Problem of universality of exponential variational expansion in similar tasks is discussed and problems of Coulomb three-body physics, which solutions at present are quite actual, are broached. Different known approaches to the problem are compared in the appendix. 38 refs.; 4 tabs.

23333 (INIS-BR—934, pp 149) **Experimental determination of total inelastic differential cross section of the electron scattering by hdyrogen at intermediate energy range.** Iga, I.; Pinheiro, J.C.; Mu-Tao, L.; Nogueira, J.C. (Sao Carlos Univ., Brazil. Dept. de Quimica). 1987. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701471/JAW. (CONF-8708216—).

From 10. workshop on nuclear physics in Brazil; Caxambu, MG, Brazil (26 Aug 1987).

23334 (INIS-BR—934, pp 151) **Photoionization followed of photoexcitation in atoms.** Baptista, G.B. (Pontificia Univ. Catolica do Rio de Janeiro, Brazil. Dept. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701471/JAW. (CONF-8708216—).

From 10. workshop on nuclear physics in Brazil; Caxambu, MG, Brazil (26 Aug 1987).

23335 (INIS-BR—934, pp 155) **Capture and loss of electrons by helium ion collisions with noble gases.** Freire Junior, F.L.; Castro Faria, N.V. de; Pinho, A.G. de. (Pontificia Univ. Catolica do Rio de Janeiro, Brazil. Dept. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701471/JAW. (CONF-8708216—).

From 10. workshop on nuclear physics in Brazil; Caxambu, MG, Brazil (26 Aug 1987).

23336 (INIS-BR—934, pp 158) **Calculation of vibrationally elastic and vibrational excitation (O->1) cross sections for low energy electron scattering by hydrogen molecule.** Mu-Tao, L.; Treu Filho, O. (Sao Carlos Univ., Brazil. Dept. de Quimica). 1987. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701471/JAW. (CONF-8708216—).

From 10. workshop on nuclear physics in Brazil; Caxambu, MG, Brazil (26 Aug 1987).

23337 (INIS-BR—934, pp 161) **Electron excitation in N/sub 2/ to a/sup 1/Pig state by electron impact.** Bielschowsky, C.E.; Nascimento, M.A.C.; Hollauer, E. (Rio de Janeiro Univ., Brazil. Inst. de Quimica; Universidade Federal Fluminense, Niteroi, Brazil. Inst. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701471/JAW. (CONF-8708216—).

From 10. workshop on nuclear physics in Brazil; Caxambu, MG, Brazil (26 Aug 1987).

23338 (INIS-mf—10839, pp 913-915) **Study of the mercury hydride molecule kinetics in a HF discharge for a potential HgH laser.** Kolbychev, G.V.; Kolbycheva, P.D. (Institute Optiki Atmosfery, Tomsk, USSR). Jun 1985. NTIS (US Sales Only), PC A99/MF A01. Order Number DE87701822/JAW. (CONF-850718—Vol.2).

From 17. international conference on phenomena in ionized gases; Budapest, Hungary (8 Jul 1985).

Experimental study on physical-chemical processes responsible for production, quenching and breakdown of HgH molecules in $A^2PI_{1}2/$ and $CHI^2\Sigma_{1}2/$ states in $Hg+H_2+He(N_2,CO)$ high-frequency discharge plasma is reported. Production channels for HgH(A) are revealed, where the HgH(X) ground state is skipped. The latter is destructed in the chemical reaction with CO molecules. Rate constants for a few quenching processes involved are given. Radiation absorption by a discharge plasma was measured and the effect of N_2 and CO admixtures was studied. The experimental results obtained were compared with the authors' earlier theoretical model for a HgH laser. 3 references, 3 figures.

23339 **(ITEP—125(1986)) Stark effect in intense field. Perturbation theory and 1/n-expansion.** Popov, V.S.; Mur, V.D.; Veinberg, V.M.; Shcheblykin, A.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1986. 29p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE87702947/JAW.

The problem of the Stark effect in a hydrogen atom is considered. The computation results of higher orders of perturbation series (PS) are briefly described. Stark shifts and widths of the grouns and excited states of the hydrogen atom in the intense electric field ϵ are computed by two independent methods: PS summation and 1/n-expansion. The first method works well at $n \to 1$, while the second fastly converges in the case of Rydberg states, $n >> 1$. 31 references, 6 figures, 2 tables.

23340 **(JINR-E—14-86-388) K-shell ionization of heavy elements induced by low energy protons.** El-Ashry, F.M.; Jaskola, M.; Bienkowski, A.; Zelazny, Z.; Osetynskij, G.M.; Pajek, M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1986. 13p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87702972/JAW.

The K-shell ionization cross sections, σ/sub KI/, have been measured for Nd, Sm, Tb, Tm, and Ta targets for incident proton energies of 2.6 MeV to 3.8 MeV. The absolute σ/sub KI/ values have been determined by normalization to the known Coulomb excitation cross sections σ/sub c/ of these target nuclei. The experimental results are compared with the predictions of the SCA, PWBA models including the electron binding, Coulomb repulsion and reltivistic correction ones. 24 references, 4 figures, 2 tables.

23341 **(KEK—86-6) Photoionization of subvalence p-subshell in alkali and alkaline-earth atoms.** Yagishita, A.; Hayaishi, T.; Itoh, Y. (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)). Nov 1986. 26p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE87703007/JAW.

Photoionization of alkali and alkaline-earth atoms has been investigated by means of a time-of-flight mass spectrometer combined with monochromatised synchrotron radiation and an atomic beam, in the wavelength region of 350 - 750 A. For alkaline-earth atoms, it has been made clear that a two-step autoionization following an innershell excitation plays an important role for doubly charged ions. For alkali atoms, relative photoionization cross sections have been measured for the first time. Moreover, a tentative assignment of spectral lines for Rb and Cs in the complex spectral region has been attemped based on the photoionization data.

23342 **(KURRI-TR—296) Proceedings of the 1st [Kyoto University] symposium on hyperfine interactions.** Mekata, Mamoru; Kawase, Yoichi (eds.). (Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst.; Fujitsu Ltd., Tokyo (Japan)). Sep 1987. 119p. (JA and English). (CONF-8707148—). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88900377/JAW.

From 1. KUR symposium on hyperfine interactions; Kyoto, Japan (20 Jul 1987).

The Japanese Symposium on Hyperfine Interactions covered topics such as Moessbauer spectroscopy, CEMS studies, nuclear magnetic resonance studies, nuclear polarization with lasers and hyperfine structure and interaction studies. Papers on these and related topics are discussed. (LSP)

23343 **(UCRL—52000-87-11-12) Energy and Technology Review, November-December 1987.** Lear, R.D.; Weber, M.J.; Crawford, R.B.; de Vore, L.; Gleason, K.; Hendry, D.P.; Kirvel, R.D.; O'Neal, E.M.; Taft, S.O. (eds.). (Lawrence Livermore National Lab., CA (USA)). Dec 1987. Contract W-7405-ENG-48. 58p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88005568/JAW.

This paper contains reports on various activities related to synchrotron radiation technology at Lawrence Livermore Laboratory. Topics include: (1) synchrotron radiation properties, (2) beamline calibration, (3) nuclear weapons testing diagnostics, (4) x-ray diffraction, (5) x-ray absorption spectroscopy, and (6) x-ray optics. (JDH)

23344 **Core hole decay of N_2O following core to bound state excitations.** Larkins, F.P.; Eberhardt, W.; Lyo, I.; Murphy, R.; Plummer, E.W. (Chemical Physics Institute, University of Oregon, Eugene, Oregon 97403). *Journal of Chemical Physics;* **88**: No. 5, 2948-2955(1 Mar 1988).

We present here a semiempirical assignment for the electronic decay spectra of core to bound state resonances in N_2O. The electronic final states observed in these spectra can be assigned to participator and spectator decay processes, according to whether the initially excited core electron participates or acts as a spectator in the Auger decay of the core hole. The participator states are interpreted empirically using the known one electron binding energies. The assignment of the spectator lines is derived from the calculated Auger spectrum which is corrected for the Coulomb interaction between the spectator electron and the double hole valence configuration.

23345 **Vertical electronic spectrum of NO_3: ^{2}A/sup '/$_2$, $^2E''(^2A_2, ^2B_1)$, and ^{2}E' states.** Kim, B.; Johnston, H.S.; Clabo D.A. Jr.; Schaefer H.F. III. (Department of Chemistry and Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Journal of Chemical Physics;* **88**: No. 5, 3204-3210(1 Mar 1988). Contract AC03-76SF00098.

Ab initio molecular quantum mechanics has been used to study the four lowest electronic states of the nitrate free radical at the D_3/sub h/ geometry deduced from experiment (1985) by Ishiwata, Tanaka, Kawaguchi, and Hirota. Basis sets ranging from double zeta (9s5p/4s2p) to triple zeta plus double polarization quality were used. Both self-consistent-field (SCF) and configuration interaction (CI) wave functions were employed, with molecular orbitals determined for the various electronic states of NO_3 and for the ground state NO^-_3 anion. The CI wave functions included single (S), double (D), and (in some cases) triple (T) excitations. The CISDT wave functions included as many as 511 474 configurations in C_s/sub v/ point group symmetry. The predicted energetic position of the ^{2}E' state agrees well with the known $T_0 = 15\ 100\ cm^{-1}$. The $^2E''$ state, found to be the lowest excited electronic state of NO_3, is predicted to lie at a vertical excitation energy of $\sim 3600\ cm^{-1}$. The relationship between this prediction and the 1986 experiments by Kawaguchi, Ishiwata, Tanaka, and Hirota suggesting an excited electronic state at $1490\ cm^{-1}$ is discussed.

23346 **Ion source for production of metastable He^+ ($2S_1$/sub //$_2$) ions.** Dunford, R.W.; Dewey, M.S. (Joseph Henry Laboratories, Princeton University, Princeton, New Jersey 08544). *Review of Scientific Instruments;* **59**: No. 3, 443-447(Mar 1988).

The construction and performance of an electron bombardment ion source designed to produce a beam of low-energy (100—400 eV) singly ionized helium (He^+) with a significant fraction of ions in the metastable $2S_1$/sub //$_2$ state is described. The source operates in the fringe field of a magnet and injects ions along the field lines into the center of the magnet. He^+ currents of up to 70 μA with small beam energy spread (3 eV) are obtained. A typical metastable fraction is 0.08% for small He^+ currents (2—5 μA).

23347 **Laser-assisted dielectronic recombination.** LaGattuta, K.J. (X-7 Group, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review Letters;* **60**: No. 8, 692-695(22 Feb 1988).

The effects of a laser beam on the dielectronic recombination (DR) of H-like ions with continuum electrons was investigated for a single-mode, circularly polarized laser with irradiance 10/sup 12/—10/sup 17/ W/cm^2 and photon energy 0.1—5.0 eV. Laser-induced increases in the value of the DR rate coefficient, up to ~100 x, were found for recombinations via the lowest-lying intermediate states, over a narrow range of the ionic charge Z, centered near Z = 5. Within this range of Z, the DR rate coefficient summed over all accessible intermediate states was increased by a factor of ~10 over its zero-field value.

23348 **1986-87 atomic mass predictions.** Haustein, P.E. (Chemistry Department, Brookhaven National Laboratory, Upton, NY 11973 USA). *AIP (American Institute of Physics) Conference Proceedings;* **164**: No. 1, 53-61(10 Dec 1987). (CONF-870970—).

From 5. international conference on nuclei far from stability; Lake Rosseau, Canada (14 Sep 1987).

A project to perform a comprehensive update of the atomic mass predictions has recently been concluded and will be published shortly in Atomic Data and Nuclear Data Tables. The project evolved from an ongoing comparison between available mass predictions and reports of newly measured masses of isotopes throughout the mass surface. These comparisons have highlighted a variety of features in current mass models which are responsible for predictions that diverge from masses determined experimentally. The need for a comprehensive update of the atomic mass predictions was therefore apparent and the project was organized and began at the last mass conference (AMCO-VII). Project participants included: Pape and Anthony; Dussel, Caurier and Zuker; Moeller and Nix; Moeller, Myers, Swiatecki and Treiner; Comay, Kelson, and Zidon; Satpathy and Nayak; Tachibana, Uno, Yamada and Yamada; Spanier and Johansson; Jaenecke and Masson; and Wapstra, Audi and Hoekstra. An overview of the new atomic mass predictions may be obtained by written request.

23349 **Measurement of inelasticities for charge correlated multiple ionization of Ne by fast C/sup 6+/ ions.** Schuch, R.; Datz, S.; Dittner, P.F.; Hippler, R.; Krause, H.F.; Miller, P.D. (Oak Ridge National Lab., TN, USA). *Nuclear Instruments and Methods in Physics Research;* **262**: No. 1, 6-9(1 Dec 1987). (CONF-8703116—). Contract AC05-84OR21400.

From US-Japan seminar on interactions of highly ionized atoms produced in heavy-ion collisions; Kobe, Japan (1 Mar 1987). Also published as CONF-8703116–4.

A description of measurements of inelasticities for multiple ionization in fast-single collisions is given for the example of 10 MeV C/sup 6+/ ions with Ne atoms. The degree of multiple ionization was determined by time-of-flight of the recoil ions, extracted by an electric field in coincidence with the projectiles. Their energy loss for a given degree of multiple ionization was measured with a position-sensitive silicon detector in the focal plane of an Elbek magnetic spectrograph with an energy resolution of about 10/sup -4/.

23350 **Multiple ionizatin and capture in relativistic heavy-ion atom collisions.** Meyerhof, W.E.; Anholt, R.; Xu Xiangyuan; Gould, H.; Feinberg, B.; McDonald, R.J.; Wegner, H.E.; Thieberger, P. (Stanford Univ., CA, USA. Dept. of Physics; California Univ., Berkeley, USA. Div. of Materials and Molecular Research; California Univ., Berkeley, USA. Accelerator and Fusion Research Div.; Brookhaven National Lab., Upton, NY, USA. Physics Dept.). *Nuclear Instruments and Methods in Physics Research;* **262**: No. 1, 10-14(1 Dec 1987). (CONF-8703116—). Contract AC03-76SF00098;AC02-76CH00016.

From US-Japan seminar on interactions of highly ionized atoms produced in heavy-ion collisions; Kobe, Japan (1 Mar 1987).

We show that in relativistic heavy-ion collisions the independent electron model can be used to predict cross sections for multiple inner-shell ionization and capture in a single collision. Charge distributions of 82- to 200-MeV/amu Xe and 105- to 955-MeV/amu U ion beams emerging from thin solid targets were used to obtain single- and multiple-electron stripping and capture cross sections. The probabilities of stripping electrons from the K, L, or M shells were calculated using the semiclassical approximation and Dirac hydrogenic wave functions. For capture, a simplified model for electron capture was used. The data generally agree with theory.

23351 **Production of very cold, highly charged ions by synchrotron radiation: Comparisons of the 'scalpel' and 'hammer' methods.** Levin, J.C.; Cederquist, H.; Short, R.T.; Sellin, I.A.; Liljebi, L.; Huldt, S.; Johansson, S.E.; Nilsson, E.; Church, D.A. (Tennessee Univ., Knoxville, USA; Oak Ridge National Lab., TN, USA; Institute of Microwave Technology, Stockholm, Sweden; Lund Univ., Sweden. Dept. of Physics; Texas A and M Univ., College Station, USA). *Nuclear Instruments and Methods in Physics Research;* **262**: No. 1, 106-109(1 Dec 1987). (CONF-8703116—). Contract AC05-84OR21400.

From US-Japan seminar on interactions of highly ionized atoms produced in heavy-ion collisions; Kobe, Japan (1 Mar 1987).

Measurements of kinetic energies of highly charged argon ions produced by inner-shell photoionization and by ion-beam impact have been made using time-of-flight techniques. High-charge-state recoil ions produced by beams of ≃ 0.5-1 MeV/u Cl/sup 5+/ are found to have energies one to two orders of magnitude higher than ions of the same charge produced by vacancy cascades following inner-shell photoionization by synchrotron radiation. The results may have application to the development of a very cold ion source useful for angle-resolved atomic collision studies.

23352 **Energies of atoms with nonspherical charge densities calculated with nonlocal density-functional theory.** Kutzler, F.W.; Painter, G.S. (Chemistry Department, Tennessee Technological University, Cookeville, Tennessee 38505). *Physical Review Letters;* **59**: No. 12, 1285-1288(21 Sep 1987).

Calculations using nonlocal density-functional theory show that the total energies of atoms in states characterized by partially filled degenerate subshells are substantially lower when the charge density is not spherically averaged. This is in contrast to the case with local density theory in which spherical and nonspherical treatments of atoms give essentially identical energies. A cooperative effect of nonlocality in the exchange-correlation functional and nonsphericity in the charge density lowers the atomic total energies and greatly improves the calculated binding energies of B_2, C_2, O_2, and F_2.

23353 **Highly resolved spectra of local modes of benzene.** Page, R.H.; Shen, Y.R.; Lee, a.Y.T. (Materials and Chemical Sciences Division, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Physical Review Letters;* **59**: No. 12, 1293-1296(21 Sep 1987). Contract AC03-76SF00098.

Rotational cooling by supersonic expansion and laser labeling spectroscopy were used to obtain high-resolution fundamental and first- and second-overtone spectra of C-H stretches of benzene in a molecular beam. Rich fine structure in the spectra has been observed. Transformation from the "normal-mode" picture to the "local-mode" picture seems to occur between v = 2 and v = 3. Vibrational lifetimes in local-mode bands exceed ≃0.5 psec.

23354 **Particle and photon interactions with surfaces.** Gruen, D.M.; Krauss, A.R.; Pellin, M.J.; Young, C.E. New York, NY; Elsevier Science Pub. Co. Inc. (1987). 252p. (CONF-860807—). Elsevier Science Pub. Co. Inc., 52 Vanderbilt Ave., New York, NY 10017.

From 6. international workshop on inelastic ion surface collisions; Argonne, IL, USA (25 Aug 1986).

This book contains papers from the Sixth International Workshop on Inelastic Ion Surfrace Collisions. There are eight sections in this book covering the following topics: theory of sputtering and molecular scattering, ion scattering and secondary ion emission, photon interactions with sputtered atoms and molecules, photon- and electron-induced desorption, energy flows in atom and molecule surface interactions, sputtering of clusters and large organic molecules, frozen gas sputtering and charge transfer at surfaces, and surface and interface chemistry induced by energetic particles.

23355 **Neutralization of TFTR neutral beams.** Gammel, G.M.; Kamperschroer, J.H.; Grisham, L.R.; Kugel, H.W.; Langley, R.A.; Roquemore, A.L.; Williams, M.D. (Plasma Physics Lab., Princeton Univ., Princeton, NJ). pp 79 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

Long pulse ion sources have recently been operated on both the injection beamlines and test stand at TFTR. Operation has shown that these ion sources can be run in a very high gas efficiency mode. Such operation unfortunately leads to under-neutralization of the extracted beam with the unpleasant side effects of increased power loading on the ion dumps, decreased neutral power, and decreased full-energy neutral fraction injected into TFTR. This effect has been studied with a set of instruments that include water-flow calorimetry, thermocouple arrays, ionization gauges, and various beam species diagnostics (optical multichannel analyzer, Rutherford backscattering, implantation and a charge exchange analyzer). As the gas efficiency is increased, the line integrated gas density of the neutralizer falls below that predicted by room temperature gas and molecular flow. This effect is evident in the reduced bulk neutralization of the beam as well as increased power on the ion dump and downward-shifting profile on the full-energy ion dump. Similar difficulties have been encountered on the JET beamlines.

6404 Fluid Physics

REFER ALSO TO CITATION(S) 22296, 22547, 23278

23356 **(DOE/ER/13044—T2) [Systems near the onset and in the well-developed regimes of turbulence].** Siggia, E.D. (Cornell Univ., Ithaca, NY (USA)). 1987. Contract AC02-83ER13044. 12p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005365/JAW.

This paper contains progress information on Painleve property and integrability, blow up in the three-dimensional Euler and Navier-Stokes equations, physics of disordered media and understanding of the interconnections between arbitrary objects constructed on binary trees, period doubling fixed points, presentation functions and scaling functions. (LSP)

23357 **(DOE/ER/13333—1) [Mixing of viscous fluids: Behavior of microstructures and chaos].** (Massachusetts Univ., Amherst (USA)). [1988]. Contract FG02-85ER13333. 37p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006287/JAW.

In spite of its universality and practical implications, the understanding of mixing of viscous fluids remains rather incomplete. More work is necessary for the establishment of a comprehensive framework capable of addressing the many problems encountered in nature and technology. This proposal focuses on basic computational and experimental studies along two main themes towards the completion of such long-range goal: investigations of chaotic mixing of single fluids in deterministic two- and three-dimensional (slow) flows, and dynamics of active microstructures in such flows (e.g., stretching, breakup, coagulation, etc.). Work in the first area is underway and a clear picture is emerging; the theme of the second area is less well defined and the proposed ideas purely exploratory. Much work remains to mesh the two levels; in this proposal we elaborate on both aspects and indicate possible lines of attack. 8 figs.

23358 **(DOE/MC/23161—2529) Characterization of aerodynamic drag force on single particles: Final report.** Kale, S.R. (West Virginia Univ., Morgantown (USA). Dept. of Mechanical and Aerospace Engineering). Oct 1987. Contract FG21-86MC23161. 114p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88001001/JAW.

An electrodynamic balance was used to measure the drag coefficient and also to record the size and shape of spheres, and coal and oil shale particles (100 μm to 200 μm in size). The electrodynamic balance consisted of a central, and two end electrodes. The resulting electric field stably suspended a charged particle. A suspended particle, back illuminated by a light emitting diode, was viewed by a video camera. The image was analyzed for particle position control and was calibrated to give the diameter of spheres, or the area equivalent diameter of nonspherical particles. The drag coefficient was calculated from the air velocity and the dc voltage required to keep the particle at the balance center. The particle Reynolds number varied from 0.2 to 13. Three particles each of coal and oil shale were captured and photographed by a scanning electron microscope and the motion of all the particles was recorded on video tape. Drag coefficient vs Reynolds number data for spheres agreed well with correlations. Data for thirteen particles each of coal and oil shale indicated a power law relationship between drag coefficient and Reynolds number. All these particles exhibited higher drag than spheres and were also observed to rotate. The rotation, however, did not affect the drag coefficient. The choice of characteristic dimension affects the drag characteristics of oil shale more strongly than for coal, owing to the flake-like shape of oil shale. 38 figs., 5 tabs.

23359 **(NRL-MR—6149) Analysis of anomalous resistivity during the conduction phase of the plasma erosion opening switch: Interim report.** Kulsrud, R.; Ottinger, P.F.; Grossmann, J.M. (Naval Research Lab., Washington, DC (USA)). 2 Feb 1988. Contract AI08-79DP40092. 30p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006382/JAW.

During the conduction phase of the plasma erosion opening switch, the current channel width in the body of the plasma away from the electrodes has been observed to be many times wider than the collisionless skin depth. Anomalous collisions have been invoked to explain this discrepancy. Here the problem is analyzed using an electrostatic Vlasov approach and an unstable ion acoustic mode is identified. The derived growth rate is fast enough and the nonlinear saturation level is high enough to explain the observed magnetic field penetration. 21 refs., 3 figs.

23360 **Annual review of numerical fluid mechanics and heat transfer. Volume 1.** Chawla, T.C. Washington, DC; Hemisphere Publishing Corp. (1987). 467p.

Numerical techniqes for the analysis of problems in fluid mechanics and heat transfer are discussed, reviewing the results of recent investigations. Topics addressed include thermal radiation in particulate media with dependent and independent scattering, pressure-velocity coupling in incompressiblefluid flow, new explicit methods for diffusion problems, and one-dimensional reaction-diffusion equations in combustion theory. Consideration is given to buckling flows, multidimensional radiative-transfer analysis in participating media, freezing and melting problems, and complex heat-transfer processes in heat-generating horizontal fluid layers.

23361 **On the implementation of kernel numerical algorithms for computational fluid dynamics on hypercubes.** Chan, T.F. (Dept. of Mathematics, UCLA, 405 Hilgard Av., Los Angeles, CA 90024). pp 747-755 of Hypercube multiprocessors 1987. Heath, M.T. Philadelphia, PA; Society for Industrial and Applied Mathematics (1987). (CONF-8609173—).

From 2. conference on hypercube multiprocessors; Knoxville, TN, USA (29 Sep 1986).

The authors discuss some issues that arise in the implementation of numerical algorithms for computational fluid dynamics (CFD) on multiprocessor systems such as hypercubes. They identify several important kernel numerical algorithms from CFD that map well onto the hypercube architecture. They emphasize the importance of considering the optimal mapping for a collection of kernel algorithms used in an application program rather than just on individual optimal mappings. Several examples illustrating the tradeoffs between rearranging data to fit a particular kernel algorithm and using suboptimal mappings will be discussed.

6450 High Energy Physics

REFER ALSO TO CITATION(S) 23974, 24017

23362 (DOE/ER/40213—3) Theory and phenomenology of strong and weak interaction high energy physics: Progress report, May 1, 1987-April 30, 1988. Carruthers, P.; Thews, R.L. (Arizona Univ., Tucson (USA). Dept. of Physics). 22 Jan 1988. Contract FG02-85ER40213. 16p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88005410/JAW.

This paper contains progress information on the following topics in High Energy Physics: strong, electromagnetic, and weak interactions; aspects of quark-gluon models for hadronic interactions, decays, and structure; the dynamical generation of a mass gap and the role and truthfulness of perturbation theory; statistical and dynamical aspects of hadronic multiparticle production; and realization of chiral symmetry and temperature effects in supersymmetric theories. (LSP)

23363 (DOE/ER/40272—49) Research in high energy elementary particle physics: Annual progress report, [March 1, 1986-February 29, 1988]. Field, R.; Ramond, P.; Thorn, C.; Avery, P.; Walker, J.; Tanner, D.; Sikivie, P.; Sullivan, N.; Majeswki, S. (Florida Univ., Gainesville (USA)). 11 Jan 1988. Contract FG05-86ER40272. 93p. NTIS, PC A05. Order Number DE88006065/JAW.

This is a progress report covering the period March 1, 1986 through February 29, 1988 for the High Energy Physics program at the University of Florida (DOE Florida Demonstration Project grant FG05-86-ER40272). Our research program covers a braod range of topics in theoretical and experimental physics and includes detector development and an Axion search. Included in this report is a summary of our program and a discussion of the research progress.

23364 (INIS-BR—917) Proceedings of the 8. National Meeting of Particle Physics and Fields - Abstracts. (Sociedade Brasileira de Fisica, Sao Paulo). 1987. 33p. (In Portuguese). (CONF-8709236—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701458/JAW.

From 8. national meeting of particle physics and fields; Caxambu, MG, Brazil (16 Sep 1987).

The results of the research programs developed in Particle Physics and Field Theory in 1987 are presented. Review lectures on the main lines of research on the subject are also presented. (M.W.O.).

23365 (INIS-mf—11105) Production of new particles in e+e/sup -/ reactions at LEP I energies. Dobado, A. (Universidad Autonoma de Madrid (Spain). Dept. de Fisica Teorica). 1987. 124p. (In Spanish). NTIS (US Sales Only), PC A06/MF A01. Order Number TI88701627/JAW.

The possibility of lep I of producing new particles is considered. We arrive at the general conclusion that lep I may make it possible to complete the detection of the particles that make up the "standard model" and, in addition, to discover some supersymmetric particle or to rule out most of the supersymmetric models.

23366 Computing environment. A summary of the Asilomar Conference on Computing in High Energy Physics. Wickens, F. (Rutherford Appleton Lab., Didcot, England). pp 1-8 of Computing in high energy physics. Ash, W. (ed.). Amsterdam, The Netherlands; North-Holland Physics Publishing (1987).

From Computing high energy physics; Pacific Grove, CA, USA (2 Feb 1987).

The Asilomar Conference on Computing in High Energy Physics took as its theme the Computing Environment. This summary paper attempts to give a broad perspective of the material presented at the conference, using a framework with an emphasis on the points of particular relevance for off-line computing by experimental high energy physicists. It can be used as an introduction and guide to the other papers or to give a relatively brief overview of their computing environment.

23367 Asilomar conference on managing complexity in high energy physics: a summary and renaming of the conference. Nash, T. (Fermi National Accelerator Lab., Batavia, IL). pp 9-14 of Computing in high energy physics. Ash, W. (ed.). Amsterdam, The Netherlands; North-Holland Physics Publishing (1987).

From Computing high energy physics; Pacific Grove, CA, USA (2 Feb 1987).

Even if it was not either conscious or deliberate, physicists at the Asilomar Conference on Computing in High Energy Physics, probably for the first time, focused a conference on the multitude of problems associated with the new scale of complexity in high energy physics experiments. This summary of the conference emphasizes issues of managing this complexity with new computer techniques. It also points to the emerging relevance of Artificial Intelligence subjects to particle physics.

23368 Software issues for large detectors. Bock, R.K. (CERN, Geneva, Switzerland). pp 15-25 of Computing in high energy physics. Ash, W. (ed.). Amsterdam, The Netherlands; North-Holland Physics Publishing (1987).

From Computing high energy physics; Pacific Grove, CA, USA (2 Feb 1987).

This talk discusses problems encountered in the High Energy Physics community with efficiently generating the software for large detectors. A more coherent approach between experiments and even between the larger institutes is advocated. Propagating their methods of the past into the now dominant engineering environment is likely to end in more or less unmanageable situations. The traditional physicist volunteers must be guided by few specially trained and experienced software leaders, who profess an inclination towards solid engineering. They should welcome all new hardware developments, but attempt less to translate them into increased CP performance than to use the offered enhancements in quality of services. Many of their problems are also experienced in other fields, but they appear enhanced in their research environment. More contacts amongst themselves, with other scientists, and with industry and Computer Science must be aimed at. 5 figures.

23369 Computing for HEP experiments: 1987-1997. Newman, H.B. (California Institute of Technology, Pasadena). pp 27-45 of Computing in high energy physics. Ash, W. (ed.). Amsterdam, The Netherlands; North-Holland Physics Publishing (1987).

From Computing high energy physics; Pacific Grove, CA, USA (2 Feb 1987).

Computers and data communications networks are essential elements of high energy physics research. The sharp rise in computing needs for the current generation of large collider experiments is just starting at the CERN and FERMILAB p anti p colliders, and it is certain to continue at TRISTAN, SLC, LEP, HERA and the SSC. The diversity and sophistication of HEP's computing facilities and networks must also increase if the potential for new physics discoveries by future experiments is to be realized. This paper reviews present and future trends in the HEP physicist's computing and networking environment. New computer architectures, personal workstations, and storage media will have a vital role to play in the offline data analysis for large experiments over the next ten years. 33 references, 9 figures, 12 tables.

23370 Multiprocessors for high energy physics. Pohl, M. (Institut fuer Hochenergiephysik, Zuerich, Switzerland). pp 47-60 of Computing in high energy physics. Ash, W. (ed.). Amsterdam, The Netherlands; North-Holland Physics Publishing (1987).

From Computing high energy physics; Pacific Grove, CA, USA (2 Feb 1987).

The author reviews the role, status and progress of multiprocessor projects relevant to High Energy Physics. A short overview of the large variety of multiprocessors architectures is given, with special emphasis on machines suitable for experimental data reconstruction. A lot of progress has been made in the attempt to make the use of multiprocessors less painful by creating a Parallel Programming Environment supporting the non-expert user. A high degree of usability has been reached for coarse grain (event level) parallelism. The program development tools available on various

systems (subroutine packages, pre-processors and parallelizing compilers) are discussed in some detail. Tools for execution control and debugging are also developing, thus opening the path from dedicated systems for large scale, stable production towards support of a more general job mix. At medium term, multiprocessors will thus cover a growing fraction of the typical High Energy Physics computing task. 31 references, 12 figures, 6 tables.

23371 **VM/CMS in the HEP community (HEPVM).** McCubbin, N.A. (Rutherford Appleton Lab., Didcot, England). pp 61-66 of Computing in high energy physics. Ash, W. (ed.). Amsterdam, The Netherlands; North-Holland Physics Publishing (1987).

From Computing high energy physics; Pacific Grove, CA, USA (2 Feb 1987).

One aspect of modern high energy physics experiments is the growing trend for physicists to make use of more than one computer installation. The overwhelming majority of HEP IBM installations offer VM/CMS as the user interface. Any large installation soon requires its own enhancements to complement basic CMS, and the primary aim of HEPVM is to coordinate these so that users see the SAME commands doing the SAME things at ALL VM sites. One of the major enhancements is the interface for batch work, which is based on work done at SLAC. Experience so far and future trends will be reviewed.

23372 **Status of (US) high energy physics networking.** Montgomery, H.E. (Fermi National Accelerator Lab., Batavia, IL). pp 77-82 of Computing in high energy physics. Ash, W. (ed.). Amsterdam, The Netherlands; North-Holland Physics Publishing (1987).

From Computing high energy physics; Pacific Grove, CA, USA (2 Feb 1987).

The current status of networking to and between computers used by the high energy physics community is discussed. Particular attention is given to developments over the last year and to future prospects. Comparison between the current status and that of two years ago indicates that considerable strides have been made but that much remains to be done to achieve an acceptable level of functionality. 15 references, 1 table.

23373 **Two years of real progress in European HEP networking: a CERN perspective.** Carpenter, B.E.; Fluckiger, F.; Gerard, J.M.; Lord, D.; Segal, B. (CERN, Geneva, Switzerland). pp 83-92 of Computing in high energy physics. Ash, W. (ed.). Amsterdam, The Netherlands; North-Holland Physics Publishing (1987).

From Computing high energy physics; Pacific Grove, CA, USA (2 Feb 1987).

The last two years have been marked by real progress in networking in HEP. Home-made developments, studies and plans have given way to the use of real networks involving hundreds of HEP and other computers and based on externally produced software and hardware. Within the last year, the first generation of industrial software products following some of the international standards for networking have become available. Related developments are taking place in networking for on-line systems and indeed the LEP experiments are distinguished by their heavy and crucial reliance on both local and wide-area networks. This paper describes the progress made at CERN since the last two years and look at perspectives for the future.

23374 **Vectorization of track finding and fitting algorithms for HEP.** Hauser, J. (Univ. of Chicago, IL). pp 121-125 of Computing in high energy physics. Ash, W. (ed.). Amsterdam, The Netherlands; North-Holland Physics Publishing (1987).

From Computing high energy physics; Pacific Grove, CA, USA (2 Feb 1987).

The applicability of vector computers toward solving the problems of drift chamber track finding and fitting is discussed. Particular attention is paid to the Mark III tracking program, which appears amenable to such vectorization. Progress in the field by other groups is also discussed, and an attempt is made to extrapolate from present experience to situations of higher multiplicity and drift chamber complexity. 6 references, 5 figures, 1 table.

23375 **EGS4V: vectorization of the Monte Carlo cascade shower simulation code EGS4.** Miura, K. (Fujitsu Ltd., Kawasaki, Japan). pp 127-136 of Computing in high energy physics. Ash, W. (ed.). Amsterdam, The Netherlands; North-Holland Physics Publishing (1987).

From Computing high energy physics; Pacific Grove, CA, USA (2 Feb 1987).

This paper describes the vectorization method for the Electromagnetic Cascade Shower Simulation Code EGS4. A new control scheme and a new data structure suitable for vectorization of the transport Monte Carlo Simulations are discussed. It is shown that a vectorized version can achieve more than 8 times performance improvement over the original scalar EGS4 code on AMDAHL 1200 Vector Processor System for a sample problem. 11 references, 9 figures, 3 tables.

23376 **Experimental HEP supercomputing at F.S.U.** Levinthal, D.; Goldman, H.; Georgiopoulos, C.; DeKeyser, J.L.; Linn, S.; Youssef, S.; Hodous, M.F. (Florida State Univ., Tallahassee). pp 137-146 of Computing in high energy physics. Ash, W. (ed.). Amsterdam, The Netherlands; North-Holland Physics Publishing (1987). Contract FC05-85ER25000;FG05-87ER40319.

From Computing high energy physics; Pacific Grove, CA, USA (2 Feb 1987).

FSU is heavily involved in FNAL experiment 711, so this was the logical place to start the investigation of possible applications of supercomputing in experimental HEP. The experiment is a double arm magnetic spectrometer triggered calorimetrically studying massive di-hadron production at high transverse momentum. The most CPU intensive tasks in the analysis of this experiment are the tracking pattern recognition and Monte Carlo simulation. It was found that extremely large performance enhancements can be achieved with such machines if the algorithms are assembled out of intrinsicly vector constructs. This usually requires changes of algorithms. These changes almost always produce codes of a simpler nature emphasizing the rule rather than the exception as in the case in scaler codes. 2 references, 5 figures

23377 **U/sub A/1 3D graphics analysis system.** Vialle, J.P. (LAPP, Annecy, France). pp 149-159 of Computing in high energy physics. Ash, W. (ed.). Amsterdam, The Netherlands; North-Holland Physics Publishing (1987).

From Computing high energy physics; Pacific Grove, CA, USA (2 Feb 1987).

For the analysis of the U/sub A/1 proton-antiproton experiment at CERN has been developed a complex graphics system with 3D dynamics and interactive capabilities, known as MERLIN. It played a key role in many aspects of off-line development and physics analysis. Both hardware and software aspects of the system are presented, its use as a tool for program development, apparatus monitoring and physics analysis is described. Ideas for improvements are also discussed. 7 figures.

23378 **PAW - towards a physics analysis workstation.** Bock, R.; Brun, R.; Couet, O.; Marin, J.C.; Nierhaus, R.; Pape, L.; Saumon, N.; Vandoni, C.; Zanarini, P. (CERN, Geneva, Switzerland). pp 181-190 of Computing in high energy physics. Ash, W. (ed.). Amsterdam, The Netherlands; North-Holland Physics Publishing (1987).

From Computing high energy physics; Pacific Grove, CA, USA (2 Feb 1987).

In recent years interactive data analysis and presentation packages have become more and more attractive on conventional timesharing systems. The advent of personal workstations with their good response time and powerful graphics capabilities is making these systems even more popular. PAW has been designed in that spirit. It combines the best features and the experience acquired with the existing systems together with the user friendliness now possible on modern workstations. Rather than being a monolithic system, which may be well suited to one operating system, PAW is built with modules which can also be used in the batch environment or by other interactive programs. PAW has been designed to work on many different configurations. 10 references, 8 figures.

23379 **Towards a personal mainframe.** Aston, D. pp 191-194 of Computing in high energy physics. Ash, W. (ed.). Amsterdam, The Netherlands; North-Holland Physics Publishing (1987).

From Computing high energy physics; Pacific Grove, CA, USA (2 Feb 1987).

Aspects of computing in a mainframe environment are discussed with reference to the SLAC installation. Personal computers have revolutionized users' expectations, yet the centralized mainframe continues to offer indispensable advantages. Many of the components of a user-friendly environment can now be identified, but much work remains to be done in order to integrate them satisfactorily. 7 references.

23380 **IDA: an interactive data analysis environment for high energy physics.** Burnett, T.H. (Univ. of Washington, Seattle). pp 195-199 of Computing in high energy physics. Ash, W. (ed.). Amsterdam, The Netherlands; North-Holland Physics Publishing (1987).

From Computing high energy physics; Pacific Grove, CA, USA (2 Feb 1987).

Only in the last few years have computers used for high energy physics analysis allowed their users significant access to the CPU in an interactive mode. This capability has led to the development of the analysis system IDA, now widely used at SLAC for DST analysis. There are two elements to the system: a format for describing data whereby each element is given a name, and elements are grouped into structures reflecting the structure of the parent analysis program; and a stand-aline program allowing the user to interactively create plots involving any function of the saved quantities, subject to any condition. 1 reference, 4 figures.

23381 **Graphical editor program: GEP.** Bassler, E. (DESY-RO2, Hamburg, West Germany). pp 201-205 of Computing in high energy physics. Ash, W. (ed.). Amsterdam, The Netherlands; North-Holland Physics Publishing (1987).

From Computing high energy physics; Pacific Grove, CA, USA (2 Feb 1987).

The Graphical Editor Program, GEP, is an interactive analysis program for high energy physics data developed at DESY. It offers many options in manipulating and presenting histograms, scatter plots or vector graphics, interactive fitting and generating new histograms or scatter plots from multidimensional distributions. 5 figures.

23382 **Development of software for ALEPH using structured techniques.** Kellner, G. (CERN, Geneva, Switzerland). pp 229-243 of Computing in high energy physics. Ash, W. (ed.). Amsterdam, The Netherlands; North-Holland Physics Publishing (1987).

From Computing high energy physics; Pacific Grove, CA, USA (2 Feb 1987).

Structured Analysis/Structured Design (de Marco, Yourdon) was chosen by the ALEPH collaboration some 2 years ago to support development of off-line and data-acquisition software in their distributed environment. After a brief introduction of the basic concepts they will show how the various methods are being applied and comment on practical experiences. A formal model is being used to describe the data and the transition from abstract data flows to real-life data will be shown. The role of automated tools to support the methodology will be stressed. These techniques have been accepted very positively by the physicists since they provide improved ways to communicate and document complex software issues without introducing burdensome overheads. 14 references, 9 figures.

23383 **Use of SA/SD methods in D0 software development.** Linnemann, J.; Featherly, J.; Gibbard, B.; Kahn, S.; Protopopescu, S.; Cutts, D.; Hoftun, J.; Brown, C.; Ito, A.; Jonckheere, A.; Raja, R. (Michigan State Univ., East Lansing). pp 245-257 of Computing in high energy physics. Ash, W. (ed.). Amsterdam, The Netherlands; North-Holland Physics Publishing (1987).

From Computing high energy physics; Pacific Grove, CA, USA (2 Feb 1987).

The D0 experiment has used the Structured Analysis/Structured Design (SA/SD) methodology in its software development for the past year. The data flow diagrams and data dictionaries of structured analysis were the primary tools used in development of an ideal model of the DO software system. These and the structure charts developed during the design phase form the basic documentation of the system. Real-time structured development techniques, e.g., state transition diagrams, are employed to describe control functions in some areas, e.g. in the calibration software. The SA/SD methodology has proven to be valuable in the formulation of ideas and in communication between software developers. The methodology and its application to D0 software are described and the benefits and problems are assessed. Problems finding adequate software tools for the VAX environment are discussed and a data dictionary manager developed by D0 using DEC RDB is described. 4 references, 6 figures.

23384 **Programming languages: time for a change?.** Russell, J.J. pp 269-273 of Computing in high energy physics. Ash, W. (ed.). Amsterdam, The Netherlands; North-Holland Physics Publishing (1987).

From Computing high energy physics; Pacific Grove, CA, USA (2 Feb 1987).

Most computer programs read like, well, computer programs? An overview of the software needs of the high-energy physics community and how modern languages can meet these needs is given. Using ADA as an example, the production of readable, efficient and maintainable code is shown to be directly supported by the language, integrating concepts such as top-down design, object-oriented programming and data encapsulation as a natural part of the language rather than as foreign ideas imposed on the language. Particular attention is paid to non-traditional aspects of a language and how these can help by providing an integrated support environment for all phases of the lifetime of the software. 2 references.

23385 **Fortran preprocessors.** Johnson, A.S. (Boston Univ., MA). pp 275-281 of Computing in high energy physics. Ash, W. (ed.). Amsterdam, The Netherlands; North-Holland Physics Publishing (1987). Contract AC02-86ER40284.

From Computing high energy physics; Pacific Grove, CA, USA (2 Feb 1987).

Despite the availability of many more powerful languages the majority of high-energy physics code is still written in Fortran. In addition many Fortran preprocessors are employed providing facilities ranging from simple conditional compilation and file inclusion to advanced macro translation. This paper reviews a variety of preprocessors currently in use in HEP experiments. This is followed by some specific examples of how preprocessors can be utilized to simulate language constructs and facilities missing in standard Fortran. 9 references, 2 tables.

23386 **Use of the ADAMO data management system within ALEPH.** Qian, Z.; Tang, S.; Zhao, W.; Fisher, S.M.; Harvey, J.; Boano, M.; Bunn, J.; McClatchey, R.; Emiliani, V.; Palazzi, P.; Brazioli, R. (IHEP, Beijing, China). pp 283-298 of Computing in high energy physics. Ash, W. (ed.). Amsterdam, The Netherlands; North-Holland Physics Publishing (1987).

From Computing high energy physics; Pacific Grove, CA, USA (2 Feb 1987).

ADAMO is a data management system for defining data and manipulating them from FORTRAN programs. A form of the Entity-Relationship (ER) model and the data flow diagrams of structured analysis have been combined to provide a system suited to algorithmic work. The FORTRAN interface consists of calls to a subroutine package with a few data manipulation primitives. Data items are visible in variables carrying meaningful names; the code is compact and readable. The ER data structures, mapped onto tables, are compatible with a relational data base management system. Tools have been written to copy tables to and from a relational data base. The system has been used for several applications in the fields of event simulation and reconstruction, online systems, detector description, support tools and packages. 25 references, 12 figures.

23387 **Database systems for HEP experiments.** Mount, R.P. (California Institute of Technology, Pasadena). pp 299-310 of Computing in high energy physics. Ash, W. (ed.). Amsterdam, The Netherlands; North-Holland Physics Publishing (1987).

From Computing high energy physics; Pacific Grove, CA, USA (2 Feb 1987).

The author reviews the role of commercial and home-made database systems in HEP experiments. He draws heavily on the qualitative and quantitative evaluations performed by the L3 offline computing group, but he also reviews some of the activities of other experiments. He considers to what extent features, such as query language, Fortran interface, efficiency, portability, robustness, security and cheapness, are needed for various applications and are offered by existing systems. The commercial systems ORACLE and SQL/DS, and the HEP-made access methods KAPACK and ZEBRA-RZ will be discussed in some detail. Finally, he presents a brief overview of the L3 database system. 5 references, 1 figure, 2 tables.

23388 **Data driven parallelism in experimental High Energy Physics applications.** Pohl, M. (Institut fuer Hochenergiephysik, Zuerich, Switzerland). pp 311-317 of Computing in high energy physics. Ash, W. (ed.). Amsterdam, The Netherlands; North-Holland Physics Publishing (1987).

From Computing high energy physics; Pacific Grove, CA, USA (2 Feb 1987).

The author presents global design principles for the implementation of High Energy Physics data analysis code on sequential and parallel processors with mixed shared and local memory. Potential parallelism in the structure of High Energy Physics tasks is identified with granularity varying from a few times 10^8 instructions all the way down to a few times 10^4 instructions. It follows the hierarchical structure of detector and data acquisition systems. To take advantage of this - yet preserving the necessary portability of the code - he proposes a computational model with purely data driven concurrency in Single Program Multiple Data (SPMD) mode. The Task granularity is defined by varying the granularity of the central data structure manipulated. Concurrent processes coordinate themselves asynchroneously using simple lock constructs on parts of the data structure. Load balancing among processes occurs naturally. The scheme allows to map the internal layout of the data structure closely onto the layout of local and shared memory in a parallel architecture. It thus allows to optimize the application with respect to synchronization as well as data transport overheads. He presents a coarse top level design for a portable implementation of this scheme on sequential machines, multiprocessor mainframes (e.g. IBM 3090), tightly coupled multiprocessors (e.g. RP-3) and loosely coupled processor arrays (e.g. LCAP, Emulating Processor Farms). 13 references, 2 figures.

23389 **ACP multiprocessor system at Fermilab.** Gaines, I.; Areti, H.; Atac, R.; Biel, J.; Cook, A.; Fischler, M.; Hance, R.; Husby, D.; Nash, T.; Zmuda, T. (Fermi National Accelerator Lab., Batavia, IL). pp 323-329 of Computing in high energy physics. Ash, W. (ed.). Amsterdam, The Netherlands; North-Holland Physics Publishing (1987).

From Computing high energy physics; Pacific Grove, CA, USA (2 Feb 1987).

The Advanced Computer Program at Fermilab has developed a multiprocessor system which is easy to use and uniquely cost effective for many high energy physics problems. The system is based on single board computers which cost under $1500 each to build including 2 Mbytes of on board memory. Expansion to 6 Mbytes is now available. These standard VME modules each run experiment reconstruction code in Fortran at speeds approaching that of a VAX 11/780. The first system, now with 100 processors, has been operated for six months, with essentially no down time, by computer operators in the Fermilab Computer Center. An interface from Fastbus to the Branch Bus has been developed for online use which has been tested error free at 20 Mbytes/s for 48 hours. ACP hardware modules are available commercially. 3 references, 3 figures.

23390 **Software for the ACP multiprocessor system.** Biel, J.; Areti, H.; Atac, R.; Cook, A.; Fischler, M.; Gaines, I.; Kaliher, C.; Hance, R.; Husby, D.; Nash, T.; Zmuda, T. (Fermi National Accelerator Lab., Batavia, IL). pp 331-337 of Computing in high energy physics. Ash, W. (ed.). Amsterdam, The Netherlands; North-Holland Physics Publishing (1987).

From Computing high energy physics; Pacific Grove, CA, USA (2 Feb 1987).

Software has been developed for use with the Fermilab ACP multiprocessor system (described in an accompanying paper). The software was designed to make a system of a hundred independent node processors as easy to use as a single, powerful CPU. Subroutines have been developed by which a user's host program can send data to and get results from the program running in each of his ACP node processors. Utility programs make it easy to compile and link host and node programs, to debug a node program on an ACP development system, and to submit a debugged program to an ACP production system.

23391 **UA1 experience with 3081/E systems.** Sphicas, P.A. (Massachusetts Institute of Technology, Cambridge). pp 339-343 of Computing in high energy physics. Ash, W. (ed.). Amsterdam, The Netherlands; North-Holland Physics Publishing (1987).

From Computing high energy physics; Pacific Grove, CA, USA (2 Feb 1987).

A Harvard/MIT collaboration has built, with support from CERN, a 3081/E farm of two processors in Cambridge, MA. The farm was completed in the beginning of 1986. It has since been used for UA1 data analysis and two full production runs have been completed so far. The system will be upgraded in the near future: the number of 3081/E's will be increased to five, and a new IBM-VME interface developed at CERN will be installed. Similar farms have either already been built (CERN, 5 emulators) or have received approval (ROME, 2 emulators). They will also be used for production and analysis of UA1 data. An overview of the status, performance and future of these systems will be given. 2 references, 2 figures, 1 table.

23392 **Parallel Monte Carlo calculations with many microcomputers.** Moatti, A.; Goldberg, J.; Memmi, G. (Technion-Israel Institute of Technology, Haifa). pp 355-359 of Computing in high energy physics. Ash, W. (ed.). Amsterdam, The Netherlands; North-Holland Physics Publishing (1987).

From Computing high energy physics; Pacific Grove, CA, USA (2 Feb 1987).

In a University environment with very many microcomputers, often idle during some part of the day, they have analyzed the structure of High Energy Physics Monte Carlo programs in an attempt to transform them into parallel algorithms which could run on such idle equipment. They present a theoretical analysis of the problem of managing a large number of distributed microcomputers under control of a central machine. Emphasis is on solving contingencies, overcoming failures and estimating the optimal efficiency. They also present a test case with a relative small sized program for the calculation of showers, which has successfully been implemented on a set of DEC-Rainbows under control of a DEC LSI-11/23. The microcomputers can be used at any time by the body of students for whom they were acquired, while the Monte Carlo monitor running on the LSI-11/23 makes use of any available microcomputer as soon as released by the user. Extrapolations to a more powerful system than the 11/23 with its memory and system limitations, and to microcomputers equipped with more memory and floating point coprocessors are also discussed. 4 references, 5 figures.

23393 **VAX-FSP loosely coupled array processors.** Grosdidier, G. (Laboratoire de l'Accelerateur Lineaire, Orsay, France). pp 361-365 of Computing in high energy physics. Ash, W. (ed.). Amsterdam, The Netherlands; North-Holland Physics Publishing (1987).

From Computing high energy physics; Pacific Grove, CA, USA (2 Feb 1987).

The main features of a VAX-FPS Loosely-Coupled Array of Processors (LCAP) set-up and the implementation of a High Energy Physics tracking program for off-line purposes will be described. This LCAP consists of a VAX 11/750 host and two FPS 64 bit attached processors. Before analyzing the performances of this LCAP, its characteristics will be outlined, especially from a users' point of view, and will be briefly compared to those of the IBM-FPS LCAP. 6 references, 1 figure, 4 tables.

23394 **Transputer arrays as FORTRAN farms for particle physics.** Glendinning, I.; Hey, A. (Univ. of Southampton, England). pp 367-371 of Computing in high energy physics. Ash, W. (ed.). Amsterdam, The Netherlands; North-Holland Physics Publishing (1987).

From Computing high energy physics; Pacific Grove, CA, USA (2 Feb 1987).

The INMOS transputer, the T414, and the newly-announced floating-point version, the T800, capable of speeds in excess of one Mflop, are powerful and versatile microprocessors which are natural building blocks for multiprocessor arrays. This paper details their experience using transputer arrays in a FORTRAN farm mode, in which each transputer runs the same program on different data, and passes the results to a host microcomputer. The transputer hardware used consists of a Meiko Computing Surface machine. Benchmark timings for the T414 are given for the LUND Monte Carlo generator FORTRAN program used to model QCD jet events. Preliminary results obtained using engineering samples of the T800 are also given. 2 references, 3 figures, 2 tables.

23395 **Role for relational databases in High Energy Physics software systems.** Lauer, R.; Slaughter, A.J.; Wolin, E. (Yale Univ., New Haven, CT). pp 373-377 of Computing in high energy physics. Ash, W. (ed.). Amsterdam, The Netherlands; North-Holland Physics Publishing (1987).

From Computing high energy physics; Pacific Grove, CA, USA (2 Feb 1987).

This paper presents the design and initial implementation of software which uses a relational database management system for storage and retrieval of real and Monte Carlo generated events from a charm and beauty spectrometer with a vertex detector. The purpose of the software is to graphically display and interactively manipulate the events, fit tracks and vertices and calculate physics quantities. The INGRES database forms the core of the system, while the DI3000 graphics package is used to plot the events. The paper introduces relational database concepts and their applicability to high energy physics data. It also evaluates the environment provided by INGRES, particularly its usefulness in code development and its Fortran interface. Specifics of the database design they have chosen are detailed as well. 6 references, 2 figures.

23396 **Data management for High Energy Physics experiments - preliminary proposals.** Olken, F.; Loken, S.C.; Rotem, D.; Shoshani, A.; Trippe, T.G. (Lawrence Berkeley Lab., CA). pp 379-383 of Computing in high energy physics. Ash, W. (ed.). Amsterdam, The Netherlands; North-Holland Physics Publishing (1987).

From Computing high energy physics; Pacific Grove, CA, USA (2 Feb 1987).

Currently HEP experimental data are reduced as they become available. They propose instead a demand driven approach to data analysis. Full analysis will be performed only as needed, in response to user queries which specify the subset of events for which reduced data is needed. To support this approach they propose to partition the datasets on the cross product of several trigger inputs, instead of storing the data in chronological order. Queries will be automatically decomposed into a set of requests against several partitions. Indexing, physically clustering the data on the logical partitions, and caching of partitions will be employed for efficiency. 4 references, 1 table.

23397 **MIDA database of the E687 μstrip vertex detector.** Menasce, D.; Sala, S. (Istituto Nazionale di Fisica Nucleare, Milano, Italy). pp 385-389 of Computing in high energy physics. Ash, W. (ed.). Amsterdam, The Netherlands; North-Holland Physics Publishing (1987).

From Computing high energy physics; Pacific Grove, CA, USA (2 Feb 1987).

A high resolution vertex detector has been realized to operate in the photoproduction experiment E687 scheduled to run at Fermilab Tevatron for heavy flavor searching [S. Sala, Proc. of Physics in Collision 3 (1983) 459]. The vertex has 12 planes of silicon microstrip chambers with more than 8000 channels, all equipped with a low noise front-end electronics and ADC read-out. The ADC module developed on purpose, has histogramming facility for each channel and makes use of look up tables for pedestal correction and gain equalization. A sophisticated database system has been developed, based on DEC DATATRIEVE. It contains general and detailed information on all the items of the vertex, such as detectors position and geometry, electronic connections, look up tables generating function, selected histograms and any useful parameter of the system. Once initialized for a given configuration, it can be manually or automatically conditions as detected by the monitor and calibration procedures. After a brief description of the detector, the general architecture and the underlying philosophy of the Database system will be discussed together with the main procedures operating on it. 6 references, 6 figures.

23398 **Monitoring of project-progress via distributed database.** Steuer, M.F. (Massachusetts Institute of Technology, Cambridge). pp 391-394 of Computing in high energy physics. Ash, W. (ed.). Amsterdam, The Netherlands; North-Holland Physics Publishing (1987).

From Computing high energy physics; Pacific Grove, CA, USA (2 Feb 1987).

A database system has been implemented for the L3-experiment at the CERN electron-positron storage ring LEP. It provides management and decision support information on construction schedule and funding profile. The programs are written in FORTRAN and run on the VAX computer, the standard of the L3-collaboration. Each responsible of the ten sub-assemblies provides a quarterly update on both progress and finance of approximately 100 tasks using interactively the project monitoring program on his local VAX. Via LEP3NET these files are then transferred to CERN where two program-chains provide bar chart stile displays and/or printouts with automatic warnings in case of cost overrun or schedule problems. 1 reference, 3 tables.

23399 **Optical storage and its possible use in High Energy Physics.** Langeveld, W.G.J. (Univ. of California, Riverside). pp 395-402 of Computing in high energy physics. Ash, W. (ed.). Amsterdam, The Netherlands; North-Holland Physics Publishing (1987).

From Computing high energy physics; Pacific Grove, CA, USA (2 Feb 1987).

This report discusses the current status of optical storage technology and the potential for optical data storage as an alternative to magnetic data storage for future experiments in high-energy physics. The industry is currently geared mostly towards small (5 1/4 inch) optical disk drives, both in Write Once, Read Multiple (WORM) and in erasable form. These drives resent no advantage to the high-energy physics community because of their limited capacity. However, 12 inch optical disk drives are suitable, though not optimal, for large-scale data collection as is common in high-energy physics. These systems are available in single units or in the form of automated juke-boxes. An optimal and relatively cost-effective system is currently in development. It makes use of write-once optical tape. Some disadvantages common to all current optical systems are the general lack of standards and the difficulty in procuring systems and media from different sources. 1 table.

23400 **Two terabyte optical archival store.** Thompson, M.; Varda, A.; DeClute, G. (Univ. of Wisconsin, Stoughton). pp 403-407 of Computing in high energy physics. Ash, W. (ed.). Amsterdam, The Netherlands; North-Holland Physics Publishing (1987).

From Computing high energy physics; Pacific Grove, CA, USA (2 Feb 1987).

The authors describe a very large archival store which has been built and is now being used as a cluster device on a cluster of VAX computers at the Physical Sciences Laboratory of the University of Wisconsin-Madison. They also give measured performances and data on the first use. The Optical Archival Store has been built to write and read files of all sizes from 1 byte to 1

Gbyte. The total capacity is 2 Tbyte (terabyte). The store has a general directory capability, and preserves the VMS protection scheme. The first access time to a random file is 35 s, and the second access time to a file on the same volume is 4 s. The principal need is for use by High Energy Physics, but other UW groups can also use the system.

23401 **Organization and maintenance of the CDF offline code on IBM VM/CMS and DEC VAX/VMS operating systems.** Chadwick, K.; Hollebeek, R.; Sinervo, P.K. (Purdue Univ., Lafayette, IN). pp 409-415 of Computing in high energy physics. Ash, W. (ed.). Amsterdam, The Netherlands; North-Holland Physics Publishing (1987). Contract AC02-76ER03071;AC02-76ER01428.

From Computing high energy physics; Pacific Grove, CA, USA (2 Feb 1987).

The CDF collaboration at FERMILAB is developing most of its offline data analysis software on the FNAL VAX cluster. However, the large amounts of computing time required to analyze the CDF data require this software to be available on several remote installations, ranging from small VAX mini-computers to large IBM and IBM-compatible mainframes. This need has been met be requiring the software to be Fortran-77 compatible and organizing the code in such a manner that it can be mapped in a natural way to several different machine architectures. The current version of the CDF code is now installed on both the FNAL VAX cluster and an IBM mainframe at University of Pennsylvania. To ensure that this rapidly evolving code remains up-to-date at the remote installation, an automated code-updating scheme has been implemented that performs daily updates of the CDF code via BITNET. This paper describes the implementation and current status of this multi-machine code management system. 7 references.

23402 **Environment for High Energy Physics code development.** Wisinski, D.E. pp 417-421 of Computing in high energy physics. Ash, W. (ed.). Amsterdam, The Netherlands; North-Holland Physics Publishing (1987).

From Computing high energy physics; Pacific Grove, CA, USA (2 Feb 1987).

As the size and complexity of high energy experiments increase there will be a greater need for better software tools and new programming environments. If these are not commercially available, then they must build them themselves. This paper describes a prototype programming environment featuring a new type of file system, a smart editor, and integrated file management tools. This environmental was constructed under the IBM VM/SP operating system. It uses the system interpreter, the system editor and the NOMAD2 relational database management system to create a software shell for the programmer. Some extensions to this environment are explored. 7 references, 5 figures.

23403 **Development of scientific software in the LISP machine environment.** Brower, R.; Giles, R.; Maturana, G. (Boston Univ., MA). pp 427-431 of Computing in high energy physics. Ash, W. (ed.). Amsterdam, The Netherlands; North-Holland Physics Publishing (1987).

From Computing high energy physics; Pacific Grove, CA, USA (2 Feb 1987).

The authors group at Boston University is involved both in field theory simulations and in the design and construction of a special purpose arithmetic processor (the Space Time Array Computer - STAC) for such applications. They have found the LISP programming language as well as the LISP Machine environment productive tools for developing scientific software and for design and software development of the STAC processor. The LISP Machine environment is integrated and interactive (allowing incremental software development) and it offers many powerful tools for abstraction and symbolic manipulation. They describe some of the issues involved in the high level formulation of algorithms in LISP as compared with FORTRAN and with the mapping from such a formulation to low level code. They also describe some of the difficulties encountered by the physicist-programmer in making the transition between traditional languages and LISP. 2 references.

23404 **Use of software engineering techniques in the design of the ALEPH data acquisition system.** Charity, T.; McClatchey, R.; Harvey, J. (CERN, Geneva, Switzerland). pp 433-441 of Computing in high energy physics. Ash, W. (ed.). Amsterdam, The Netherlands; North-Holland Physics Publishing (1987).

From Computing high energy physics; Pacific Grove, CA, USA (2 Feb 1987).

The SASD methodology is being used to provide a rigorous design framework for various components of the ALEPH data acquisition system. The Entity-Relationship data model is used to describe the layout and configuration of the control and acquisition systems and detector components. State Transition Diagrams are used to specify control applications such as run control and resource management and Data Flow Diagrams assist in decomposing software tasks and defining interfaces between processes. These techniques encourage rigorous software design leading to enhanced functionality and reliability. Improved documentation and communication ensures continuity over the system life-cycle and simplifies project management. 7 references, 9 figures.

23405 **Networking through the new phone system; the future of telecommunications.** Struven, W. pp 443-446 of Computing in high energy physics. Ash, W. (ed.). Amsterdam, The Netherlands; North-Holland Physics Publishing (1987).

From Computing high energy physics; Pacific Grove, CA, USA (2 Feb 1987).

This paper presents an overview of telecommunications from 1850 to the present as a background. Other topics include the Bell System breakup, current Pulse Code Modulation (PCM) problems related to T1 transmission, the implementation and early testing of ISDN (Integrated System Digital Network), the Stanford University phone system and their Bell Canada test facility, Fiber Optics technology and applications, applicable IEEE standards and VSAT networks. The paper also contrasts PBX-LAN systems, and describes the Stanford Linear Detector data-message network as well as Research Networks and other Academic Networks world-wide. 1 reference.

23406 **DECNET/IBM gateway for 3270 remote terminal access to IBM systems from VAX nodes of a DECNET network.** Ghiselli, A. (Istituto Nazionale Fisica Nucleare, Bologna, Italy). pp 447-453 of Computing in high energy physics. Ash, W. (ed.). Amsterdam, The Netherlands; North-Holland Physics Publishing (1987).

From Computing high energy physics; Pacific Grove, CA, USA (2 Feb 1987).

This paper describes terminal access to IBM Systems from VAX nodes of a DECNET Network through the 3270 terminal emulation protocol. Each IBM system is connected to one of the VAX nodes through a BSC-synchronous line. This link is handled by the DEC-3271 Protocol Emulator that allows VT100 terminals of the VAX to appear as real 3270 terminals. As the 3270 terminal is full screen oriented, whereas the DECNET Virtual Terminal is line oriented, remote access to the IBM from any node of the DECNET network through the DECNET Virtual Terminal is inefficient and a different mechanism must be found. A remote resource access mechanism, based on the concept of the pseudodevice that can access through the network to the real device, allows the 3270 terminal emulator to run on each DECNET node with the same efficiency as running on the VAX directly connected to the IBM. At present this application is installed on each VAX node of the Italian High Energy Physics Network and it provides 3270 terminal access to the IBMs of the main Italian Computer Centers as well as to the IBM at CERN. 6 references, 8 figures.

23407 **Network operating system.** Perotto, E. (CNUCE, Pisa, Italy). pp 455-466 of Computing in high energy physics. Ash, W. (ed.). Amsterdam, The Netherlands; North-Holland Physics Publishing (1987).

From Computing high energy physics; Pacific Grove, CA, USA (2 Feb 1987).

The Network Operating System is an addition to CMS designed to allow multitasking operation, while conserving all the facilities of CMS: file system, interactivity, high level language envi-

ronment. Multitasking is useful for server virtual machines, e.g. Network Transport Managers, File Managers, Disk Space Managers, Tape Unit Managers, where the execution of a task involves long waits due to I/O completion, VMCF communication delays or human responses, during which the task status stays as a control block in memory, while the virtual machine serves other users executing the same lines of code. Multitasking is not only for multiuser service: a big data reduction program may run as a main task, while a side task, connected to the virtual console, gives reports on the ongoing work of the main task in response to user commands and steers the main task through common data. All the service routines (Wait, Create and Delete Task, Get and Release Buffer, VMCF Open and Close Link, Send and Receive, I/O and Console Routines) are FORTRAN callable, and may be used from any language environment consistent with the same parameter passing conventions. The outstanding feature of this system is efficiency, no user defined SVC are used, and the use of other privileged instructions as LPSW or SSM is the bare necessary, so that CP (with the associated overhead) is not too involved. System code and read-only data are write-protected with a different storage key from CMS and user program.

23408 **Experience with the MAC data flow system.** Delfino, M.C. (Univ. of Wisconsin, Madison). pp 467-471 of Computing in high energy physics. Ash, W. (ed.). Amsterdam, The Netherlands; North-Holland Physics Publishing (1987). Contract AC02-81ER40025;AC02-76ER00881.

From Computing high energy physics; Pacific Grove, CA, USA (2 Feb 1987).

An overview of the data flow system used by the MAC detector at SLAC is given, with emphasis on three features of its environment: First, the tapeless data logging and automated raw data file fetch and filter job submission. Second, the interactive aspects of the offline analysis program, including the availability of the symbolic debugging; and third, the availability of a large amount of disk space (> 2 GB) for data files, which allows minimum use of magnetic tape for physics analysis. Figures on reliability and number of tape mounts are compared to those of typical detectors using more traditional environments. 2 references, 1 table.

23409 **Producing and supporting sharable software.** Johnstad, H.; Nicholls, J. (Fermilab, Batavia, IL). pp 473-474 of Computing in high energy physics. Ash, W. (ed.). Amsterdam, The Netherlands; North-Holland Physics Publishing (1987).

From Computing high energy physics; Pacific Grove, CA, USA (2 Feb 1987).

Although software is critical to the success of any high energy experiment, the effort involved in planning and implementation is often under-estimated. The need for sharable software, advanced tools, and enhanced support is assessed. The results of a questionnaire on software issues are presented. One conclusion from this inquiry is that there is a mandate for a regularly-scheduled US forum on software issues in HEP. 3 references.

23410 **Standard and graphics libraries in on-line environment. A comparative study of performance.** Stanescu, C. (INFN-Sanita, Rome, Italy). pp 475-478 of Computing in high energy physics. Ash, W. (ed.). Amsterdam, The Netherlands; North-Holland Physics Publishing (1987).

From Computing high energy physics; Pacific Grove, CA, USA (2 Feb 1987).

The use of graphics packages based on GKS standard raises, in general, and in on-line environment in particular, the question of performances, especially if compared to the native graphics libraries. While the use of standards facilitates the storing and the exchange of information, one can normally expect a certain degradation of performance. But how heavy this degradation is? This work contains the results obtained by an application program using a native library and then a mb version of GKS interface, purposely developed for the same graphics terminal, to represent e^+e^- simulates events. Comparative data for the CPU load and the display list dimension are presented. 3 references, 2 figures, 2 tables.

6451 Particle Interactions And Properties - Experimental

REFER ALSO TO CITATION(S) 22511, 23242, 23365, 23477, 23484, 23577, 23578, 23582

23411 **(ANL-HEP-CP—87-110) Polarization experiments at Fermilab (E-581/704).** Yokosawa, Akihiko. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 17p. (CONF-8709234—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005931/JAW.

From Workshop on the experimental program at UNK; Protovino, USSR (14 Sep 1987).

The Fermilab polarized beam and antiproton beams in the MP beam line are described. The Fermilab polarized-beam program using this facility are presented.

23412 **(BNL—40586) Comments from direct photon round table discussion.** Tannenbaum, M.J. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 6p. (CONF-8710276—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005611/JAW.

From Advanced research workshop on QCD hard hadronic processes; St. Croix, Virgin Islands, U.S. (8 Oct 1987).

This paper discusses direct photons as a result of hadron collisions, including theoretical predictions, experimental results, and directions for future work. 9 refs., 1 fig. (LSP)

23413 **(BNL—40643) Preliminary spectrometer results from E-802.** Miake, Y.; Stephans, G.S.F. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016;W-31109-ENG-38;AC03-76SF00098;AC02-78EV04968. 13p. (CONF-8708202—5). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006364/JAW.

From Quark matter '87: 6th international conference on ultra-relativistic nucleus-nucleus collisions; Schloss Nordkirchen, F.R. Germany (1 Aug 1987).

This report presents preliminary spectrometer results from the E-802 experiment at the Tandem-AGS accelerator complex at Brookhaven National Laboratory. The data presented were taken in late April of 1987 using a 14.5 GeV/c per nucleon ^{28}Si beam from the AGS. Data were obtained for a variety of targets and spectrometer settings, but we present here the analysis of data for one target-angle combination: a Au target wth the spectrometer spanning 14° to 28° in the lab. At this energy the laboratory mid-rapidity angle in N-N collisions is $\approx$ 21°. A higher K^+/π^+ ratio than K^-/π^- ratio is observed. The primary goal for the E-802 experiment is to measure inclusive particle spectra with good particle identification (PID) over a wide range of rapidity and transverse momentum, and to correlate these spectra with observables that characterize the vent topology such as total charged particle multiplicity and neutral transverse energy. The acceptance of the spectrometer is large enough to span roughly one unit of rapidity in a single setting and is adequate for studies of particle-particle correlations. The spectrometer is also sufficiently compact (6.5 m in length) to allow a reasonable fraction of low momentum pions and kaons to traverse the entire particle identification system. Segmentation for the tracking and PID counters was designed to handle particle multiplicities up to 15 through the spectrometer and 20 in front of the magnet.

23414 **(CERN-EP—87-39) Low and high resolution protonium spectroscopy at LEAR in ACOL time: Tools for glueball, hybrid and light meson spectroscopy and for measuring the N anti N strong interaction dependence on angular momentum.** Gastaldi, U. (European Organization for Nuclear Research, Geneva (Switzerland)). 20 Feb 1987. 22p. (CONF-8609386—1). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88900422/JAW.

From International school of physics with low energy antiprotons: fundamental interactions; Erice, Italy (27 Sep 1986).

Low energy resolution protonium spectroscopy with a large acceptance and high granularity X-ray Drift Chamber offers a new physical instrument to study the dependence of p anti p annihilation at rest on angular momentum and to search for glueball, hybrid,

multiquark and conventional mesonic states with narrow and also broad width. This tool has been developed at LEAR within the ASTERIX experiment and will be systematically or in part employed in ACOL time by two new experiments concerned with hadron spectroscopy and dynamics of nucleon-antinucleon interactions. High energy resolution protonium spectroscopy is feasible with an improvement by a factor 1000 over pre-ACOL experiments by using beams of p-anti p atoms produced in flight inside LEAR (where H^- ions have to co-rotate with the anti p coast) and going to a detection equipment external to the ring. The limit to the best relative energy resolution attainable is given by the relative momentum dispersion $\Delta p/p$ of the beams stored in LEAR. The shift and broadening induced by strong interactions on the four sublevels of the 2P level become therefore measurable, and precise measurements on these quantities look feasible for the two sublevels of the 1S ground state. In the second part of this paper we review this approach to high resolution protonium spectroscopy (IDEFIX experiment) and its feasibility aspects. 61 refs., 5 figs., 3 tabs.

23415 **(IFVE-OEF—86-239) π/sup -/+p -> f/sub 2/(1270) + n reaction in the -t < 2.0 (GeV/c)/sup 2/ region at 40 GeV/c.** Apokin, V.D.; Arestov, Yu.I.; Belikov, N.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701049/JAW.

Differential cross section in the charge-exchange reaction π/sup -/ + p -> f/sub 2/(1270)+n at 39.1 GeV/c has been measured in the squared four-momentum transfers -t region up to 2 (GeV/c)/sup 2/. For the first time two exponential slopes A/sub 1/=(8.6 +- 0.9) and A/sub 2/=(3.1 +- 0.4) (GeV/c)/sup -2/ have been observed in the region -t < 0.4 and -t > 0.4 (GeV/c)/sup 2/, respectively. The f/sub 2/(1270) total production cross section in this reaction at 39.1 GeV/c is equal to (4.2 +- 0.2 +- 1.1) μb. 8 refs.; 5 figs.; 2 tabs.

23416 **(IFVE-OEF—87-88) Study on neutral decays of the eta'(958) meson.** Aldi, D.; Binon, F.; Brikman, K. and others. (Los Alamos National Lab., NM (USA); Institut Interuniversitaire des Sciences Nucleaires, Brussels (Belgium)). (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. 12p. (In Russian). (SERP-E—140). NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701588/JAW.

Submitted to the journal Sov. J. Nucl. Phys. .

The partial widths of eta'-meson decays into 2γ, $\omega\gamma$, 3π/sup 0/ and etaπ/sup 0/π/sup 0/ have been measured. The upper limits for eta'-meson decays into 3γ, π/sup 0/$\gamma\gamma$, 2π/sup 0/ and 4π/sup 0/ are obtained. The linear matrix element slope for G-parity violating decay eta' -> 3π/sup 0/ has been determined. The experiment has been performed with high accuracy at the 70 GeV IHEP accelerator. The hodoscope multiphoton spectrometer GAMS-2000 has been used to detect γ quanta from eta' decays. 15 refs.; 8 figs.; 1 tab.

23417 (INIS-BR—917, pp 13) **Measures of the cosmic radiation anisotropy in Chacaltaya.** Morello, C.; Navarra, G.; Vellande, A.; Chinellato, J.A.; Manganote, E.J.T.; Turtelli Junior, A. (Instituto di Cosmo-Geofisica, Torino, Italy; Instituto de Investigaciones Fisicas, La Paz, Bolivia; Universidade Estadual de Campinas, Brazil. Inst. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701458/JAW. (CONF-8709236—).

From 8. national meeting of particle physics and fields; Caxambu, MG, Brazil (16 Sep 1987).

23418 (INIS-BR—917, pp 14) **Exotic interactions produced in emulsion chambers.** Amato, N.M.; Arata, N. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1987. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701458/JAW. (CONF-8709236—).

From 8. national meeting of particle physics and fields; Caxambu, MG, Brazil (16 Sep 1987).

23419 (INIS-BR—917, pp 14) **'Spike-Like Events' in PI/sup +/P reactions at 360Gev/c (NA27-NOBC Collaboration) and distribution of pseudo-rapidity of the difraction dissociation of beam and target in (PI/sup +/, K/sup +/, P) at 250Gev/c (Colaboracao NA22).** Endler, A.M.F.; Oliveira, L.C.S. de. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1987. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701458/JAW. (CONF-8709236—).

From 8. national meeting of particle physics and fields; Caxambu, MG, Brazil (16 Sep 1987).

23420 **(ITEP—160(1985)) Backward pion-deuteron elastic scattering from 1.75 to 3.1 GeV/c.** Abramov, V.M.; Ajrapetov, E.A.; Bagdasaryan, L.S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1985. 8p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87702951/JAW.

Measurements of the differential cross sections for π^-d elastic scattering in the backward angular region ($-1 \leqq \cos\Theta$/sub c.m.s./ $\leqq -0.98$) are presented. These measurements were made at nine incident pion momenta P/sub π/ ranging from 1.75 to 3.09 GeV/c and at largest values of q^2 (up to 7 $(GeV/c)^2$) ever reached experimentally, here q^2 is the momentum transfer squared. The differential cross sections were found to decrease rapidly with increasing momentum $d\sigma/d\Omega$/sub c.m.s./ (180 deg) — P/sub π//sup -15.7/, $d\sigma/dt$ — (q^2)/sup -12.8/. The data are compared with predictions of Regge and quark bag models. 15 references, 1 figure, 1 table.

23421 **(JINR—R-1-86-838) Resonance production cross sections in the p-barp -> p-barpπ/sup +/π/sup -/π/sup 0/ reaction at 22.4 GeV/c.** Batyunya, B.V.; Boguslavskij, I.V.; Bruntsko, D. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1986. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701153/JAW.

The method of separation of p-barp -> p-barpπ/sup +/π/sup -π0/ reaction at 22.4 GeV/c on films from the "Ludmila" bubble chamber is described. The cross section of this reaction is equal to 1.55 +- 0.13 mb. The cross sections of resonances Δ/sup ++/(1236), N*(1800), ω-, rho-mesons have been determined. The energy dependences of ω-meson and isobar N*(1800) production cross section are discussed. 22 refs.; 7 figs.; 3 tabs.

23422 **(JINR-R—1-86-720) πi -> $e^+\nu$a (a -> e^+e^-) and $\pi^+ \to \mu^- e^+ e^+ \nu$ decays.** Mzhaviya, D.A.; Korenchenko, S.M.; Kostin, B.F.; Mitsel'makher, F.V.; Nekrasov, K.G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1986. 2p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87702976/JAW.

Submitted to the journal Sov. J. Nucl. Phys.

The experimental data earlier obtained in the Laboratory of Nuclear Problems of JINR at the search for the decay $\pi^+ \to e^+\nu e^+ e^-$ having been analysed, branching ratio limitations are found for: 1)$\pi^+ \to e^+\nu$a with production of a light neutral particle (e.g. an axion), decaying into an e^+e^- pair: W/sub π(sup +)->e(sup +)νa//W/sub π->$\mu\nu$/ < 1.3×10^{-8} and 2)$\pi^+ \to \mu^- e^+ e^+ \nu$, breaking the lepton charge: W/sub π(sup +)->μ(sup -)/e/sub (sup +)e(sup +)ν//W/sub π->$\mu\nu$/ < 7.7×10^{-6}. 6 references.

23423 **(LBL—24497) Detecting the heavy Higgs boson at the SSC.** Cahn, R.N.; Chanowitz, M.; Golden, M.; Herrero, M.J.; Hinchliffe, I.; Wang, E.M.; Paige, F.E.; Gunion, J.F.; Gilchriese, M.G.D. (Lawrence Berkeley Lab., CA (USA); Brookhaven National Lab., Upton, NY (USA); California Univ., Davis (USA). Dept. of Physics). 18 Dec 1987. Contract AC03-76SF00098;AC02-76CH00016. 49p. (CONF-870739—16). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005739/JAW.

From Workshop on experiments, detectors, and experimental areas for the supercollider; Berkeley, CA, USA (7 Jul 1987).

Detection of a heavy Higgs boson (2M/sub z/ < M/sub H/ < 1 TeV) is considered. The production mechanisms and back-

grounds are discussed. Their implementation in the PYTHIA and ISAJET Monte Carlo programs are checked. The decay modes H → ZZ → llll and H → ZZ → llνν are discussed in detail. The signal/background is evaluated and some relevant detector parameters are specified. Some remarks are also made concerning the requirements imposed on detectors by the decay mode H → WW → lν + jets. Experimental signatures for models in which there is no Higgs boson of mass less than 1 TeV are outlined. 44 refs.

23424 (OUP—87-39) **Observation of a leading meson in anti p + Ne reactions at 607 MeV/c incident momentum. CERN-experiment PS-179.** Balestra, F.; Bussa, M.P.; Busso, L. and others; Bergen-Brescia-Dudna-Frascati-Oslo-Pavia-Torino Collaboration. (Turin Univ. (Italy)). (Oslo Univ. (Norway). Fysisk Inst.). Dec 1987. 13p. NTIS (US Sales Only), PC A03/MF A01. Order Number TI88752495/JAW.

A pion or a kaon may behave as a leading particle in anti p + Ne reactions at 607 MeV/c incident momentum, consistent with baryon exchange to the beam vertex or with quark fragmentation as if the incident antiproton is not annihilated as a particle. The emission of the lambdas is consistent with the evaporation model.

23425 (SLAC—315, pp 1-40) **Status report on lepton identification.** Hawkes, C. Jul 1987. NTIS, PC A 14. Order Number DE88002997/JAW. (CONF-870298—).

From 3. MARK II workshop on SLC physics; Watsonville, CA, USA (25 Feb 1987).

Electron identification using the dE/dx, time of flight and barrel and endcap calorimeter systems of the Mark II/SLC detector is described. Muon identification is also discussed. 9 references, 15 figures, 6 tables.

23426 (SLAC—315, pp 41-54) **Review of proton-antiproton collider physics relevant to the Mark II.** Goldhaber, G. Jul 1987. NTIS, PC A 14. Order Number DE88002997/JAW. (CONF-870298—). Contract AC03-76SF00098.

From 3. MARK II workshop on SLC physics; Watsonville, CA, USA (25 Feb 1987).

This talk is based on an experimental summary talk given at the 6th Topical Workshop on Proton-Antiproton Collider Physics (Aachen, 30 June - 4 July 1986) as well as on additional data learned about during a 6 month stay at CERN. In particular, where appropriate the numbers quoted have been updated as of December 6, 1986. Survey of W/sup +/-/ and Z^0 luminosity and numbers of events: integral Ldt = 729 (UA1) + 880 (UA2) nb^{-1}; W → e nu ~ 500 UA1 + UA2; W → μ nu ~ 65 UA1; W → tau nu ~ 30 UA1 - $Z^0 \rightarrow e^+e^-$ 69 UA1 + UA2; → $\mu^+\mu^-$ 19 UA1. 2 references, 8 figures, 4 tables.

23427 (SLAC—315, pp 55-62) **Pajaro Dunes Workshop summary.** Feldman, G. Jul 1987. NTIS, PC A 14. Order Number DE88002997/JAW. (CONF-870298—).

From 3. MARK II workshop on SLC physics; Watsonville, CA, USA (25 Feb 1987).

A summary is given of the workshop. Some accomplishments of the study are as follow: 1) radiative corrections; 2) physics of polarization; 3) neutrino counting on the Z; 4) B tagging; 5) hadronic Monte Carlo; and 6) new particle searches. 24 references, 3 tables

23428 (SLAC—315, pp 63-98) **Z^0 measurements: the theory and the practice.** Rankin, P. Jul 1987. NTIS, PC A 14. Order Number DE88002997/JAW. (CONF-870298—).

From 3. MARK II workshop on SLC physics; Watsonville, CA, USA (25 Feb 1987).

This report is based on the efforts of the members of Working Group 1. The group has worked hard for the last eighteen months not only to ensure that the Mark II experiment is ready to measure as accurately as possible the mass, width and total cross section of the Z^0 resonance, but also to make clear the theoretical importance of these measurements. This report is intended to serve both as a summary of what has been learnt and as an introduction to the work to follow. The next section consists of a brief description of the Standard Model and of the basic relationships between the coupling strengths, the Z^0 mass, width and cross section, and the particle content of the model. The third section discusses the experimental measurement of the mass, width and total cross section of the Z^0 and how the accuracy of these measurements will be constrained by experimental limitations. This is followed by an introduction to the theoretical complexities involved in extracting parameters from the Z^0 line shape to use in tests of the Standard Model. The report concludes with a summary of the dominant errors and uncertainties. 30 references, 7 figures.

23429 (SLAC—315, pp 99-109) **Beam energy measurements for the first 3 months of SLC operation.** Wormser, G. Jul 1987. NTIS, PC A 14. Order Number DE88002997/JAW. (CONF-870298—).

From 3. MARK II workshop on SLC physics; Watsonville, CA, USA (25 Feb 1987).

The present schedule allows 3 months of data taking for the Mark II collaboration in the summer 1987. 1000 Z^0 events may be recorded during that period. Even with this limited sample, the statistical error on the Z^0 mass will be as good as 150 MeV. Therefore, systematics errors may become dominant. In fact, during this data taking period, the Beam Energy Spectrometer will not be ready. Thus, the only information available will come the SLC machine itself and more precisely, from its three distinct elements, the Linac, the Arcs and the Final Focus systems. The following sections deal with the quality of the measurement performed in each of these systems. There are 2 different sources of systematic errors: (1) the relative errors are the errors associated with 1 measurement compared to another one: they include all the time dependent effects and the statistical precision of each measurement. Those errors govern the width resolution of the Z^0; (2) the absolute errors are the quadratic sum of the relative errors and all sources of errors which are not time dependent, i.e. the reference magnetic field mapping, the positions of the detectors,... those errors govern the mass resolution of the Z^0. It is also worthwhile to notice that some errors can be reduced if the sum of the electron and the positron beams energy is measured, instead of measuring each energy separately. 4 figures, 2 tables.

23430 (SLAC—315, pp 110-115) **BREM5 electroweak Monte Carlo.** Kennedy, D.C. II. Jul 1987. NTIS, PC A 14. Order Number DE88002997/JAW. (CONF-870298—).

From 3. MARK II workshop on SLC physics; Watsonville, CA, USA (25 Feb 1987).

This is an update on the progress of the BREMMUS Monte Carlo simulator, particularly in its current incarnation, BREM5. The present report is intended only as a follow-up to the Mark II/Granlibakken proceedings, and those proceedings should be consulted for a complete description of the capabilities and goals of the BREMMUS program. The new BREM5 program improves on the previous version of BREMMUS, BREM2, in a number of important ways. In BREM2, the internal loop (oblique) corrections were not treated in consistent fashion, a deficiency that led to renormalization scheme-dependence; i.e., physical results, such as cross sections, were dependent on the method used to eliminate infinities from the theory. Of course, this problem cannot be tolerated in a Monte Carlo designed for experimental use. BREM5 incorporates a new way of treating the oblique corrections, as explained in the Granlibakken proceedings, that guarantees renormalization scheme-independence and dramatically simplifies the organization and calculation of radiative corrections. This technique is to be presented in full detail in a forthcoming paper. BREM5 is, at this point, the only Monte Carlo to contain the entire set of one-loop corrections to electroweak four-fermion processes and renormalization scheme-independence. 3 figures.

23431 (SLAC—315, pp 116-152) **Radiative corrections to the Z^0 resonance.** Alexander, J.; Bonvicini, G.; Drell, P.; Frey, R. Jul 1987. NTIS, PC A 14. Order Number DE88002997/JAW. (CONF-870298—).

From 3. MARK II workshop on SLC physics; Watsonville, CA, USA (25 Feb 1987).

The experimental evidence supporting the standard model of electroweak interactions is impressive. Perhaps most spectacular of all has been the direct observation of the Z^0. Once one can directly produce Z^0's, one is in an excellent position to do detailed studies of the electroweak interaction, both by studying in Z^0 decays how the Z^0 couples to the matter field of quarks and leptons, and by

precision measurements of the resonance itself. In section 1 radiative corrections to first order will be reviewed. Results will be added to higher orders in section 2, and we discuss, quantitatively, the necessary accuracy of the calculations. The third section will present the radiative corrections form a structure function point of view. The advantages of this method will be discussed and in section 4, a numerical comparison of all the available calculations will be presented. Section 5 will discuss currently available MC event generators, and in section 6 new calculations will be used to refit the J/psi resonance. 24 references, 10 figures, 3 tables

23432 (SLAC—315, pp 153-164) **Mark II/SLC luminosity measurements.** Matthews, J. Jul 1987. NTIS, PC A 14. Order Number DE88002997/JAW. (CONF-870298—).

From 3. MARK II workshop on SLC physics; Watsonville, CA, USA (25 Feb 1987).

The luminosity requirements for Z0 physics have been studied for a number of the major Mark II/SLC physics topics. For at least some of the physics, the luminosity should be measured with an absolute precision better than 2%, and any systematic dependence of the luminosity on the beam energy should be less than 1% across the Z0. These requirements are reviewed in Section II. The Mark II/SLC luminosity monitors are presented in Section III, as well as the results of the analyses of the systematic uncertainties in the luminosity measurements. Finally, the results are summarized in Section IV. 13 references, 3 figures.

23433 (SLAC—315, pp 165-168) **Measurement of the total hadronic cross sections.** Feldman, G. Jul 1987. NTIS, PC A 14. Order Number DE88002997/JAW. (CONF-870298—).

From 3. MARK II workshop on SLC physics; Watsonville, CA, USA (25 Feb 1987).

The message of this note is simple. It is to point out that at the SLC they should be able to measure the total hadronic cross section with very high efficiency, and thus with very small systematic error.

23434 (SLAC—315, pp 169-171) **Possibility of measuring the number of neutrinos species to a precision of 1/2 species with only 2000 Z events.** Feldman, G. Jul 1987. NTIS, PC A 14. Order Number DE88002997/JAW. (CONF-870298—).

From 3. MARK II workshop on SLC physics; Watsonville, CA, USA (25 Feb 1987).

This note is to show that due to a fortuitous cancellation of statistical errors it will be possible to measure the number of neutrino species during their first runs with much more precision than had been previously thought possible. The partial Z width to invisible particles, Gamma/sub invis/, will turn out to be better determined than the total Z width, Gamma/sub tot/ by about a factor of $\sqrt{2}$. Furthermore, this measurement will not presuppose the existence or non-existence of the top quark or any other new physics that yields hadronic-like events. 1 table.

23435 (SLAC—315, pp 172-195) **Tau physics at the Z^0.** Cords, D.; Burchat, P.; Grosse-Wiesmann, P.; Heusch, C.; Matthews, J.; Smith, J.; Stoker, D.; Watson, S. Jul 1987. NTIS, PC A 14. Order Number DE88002997/JAW. (CONF-870298—).

From 3. MARK II workshop on SLC physics; Watsonville, CA, USA (25 Feb 1987).

The precision study of tau-pair production at the Z^0 is an essential ingredient in the investigation of the Standard Model, and in searches for deviations from the Standard Model. The plan of this note is as follows. First they review in section 2 the asymmetry measurements which, in addition to the precision measurement of the tau pair cross section, provide information on the tau (and electron) neutral current couplings. The measurement of the mean polarization of the taus, P/sub tau/, and the tau polarization forward-backward asymmetry, A/sub FB//sup pol/, is summarized in section 3. The Monte Carlo programs that have been developed for tau analysis are discussed in section, and the procedures for data selection developed with the Mark II/SLC PEP data are presented in section 5. Completing the discussion of experimental details, they present in section 6 an analysis of the systematic errors relevant to the measurement of the tau polarization. Finally in section 7 they present a number of possibilities for new physics that might be visible in the tau data at the Z^0. 17 references, 8 figures, 6 tables.

23436 (SLAC—315, pp 196-241) **Searches for the top quark.** Hanson, G.G. Jul 1987. NTIS, PC A 14. Order Number DE88002997/JAW. (CONF-870298—).

From 3. MARK II workshop on SLC physics; Watsonville, CA, USA (25 Feb 1987).

This report for the Mark II Pajaro Dunes Workshop summarizes the work of the Open Top Subgroup. The status of searches for the top quark is presently somewhat ambiguous and a bit discouraging. UA1 now seems to see no signal attributable to top production, but they still have not set a limit. However, the Open Top Subgroup is still optimistic that top may be found at the SLC. The search methods used could also be applied to other heavy particles and so are worth trying on SLC data. The work has been divided into three main topics: (1) establishing a top signal; (2) measuring the top mass; (3) establishing that what is found is really top. In the following Chapters the Monte Carlo models, cross sections and analysis procedures will be discussed, followed by the specific work on these topics. 15 references, 27 figures, 8 tables.

23437 (SLAC—315, pp 242-252) **Heavy charged lepton search.** Gan, K.K. Jul 1987. NTIS, PC A 14. Order Number DE88002997/JAW. (CONF-870298—).

From 3. MARK II workshop on SLC physics; Watsonville, CA, USA (25 Feb 1987).

This paper describes a study of some search methods for a new heavy charged lepton at SLC. 4 references, 7 figures.

23438 (SLAC—315, pp 253-316) **Searches for Higgs pairs.** Komamiya, S. Jul 1987. NTIS, PC A 14. Order Number DE88002997/JAW. (CONF-870298—).

From 3. MARK II workshop on SLC physics; Watsonville, CA, USA (25 Feb 1987).

Possible non-minimal Higgs boson searches at SLC on the Z^0 peak are surveyed. Especially, the pair production of charged Higgs bosons ($e^+e^- \rightarrow H^+H^-$) and that of two different neutral Higgs bosons ($e^+e^- \rightarrow$ H/sub i/^{0} H/sub j/^{0}) are studied. The expected event topology varies with the mass spectra of the Higgs bosons. With a relatively small number of events in the early SLC running period (with $\approx$ 10,000 Z^0's), they may have a hint of the evidence of the process $e^+e^- \rightarrow H^+H^- \rightarrow$ q'anti q + q-anti q' by reconstructing the jet-jet invariant mass peak. The process $e^+e^- \rightarrow$ H/sub i/^{0}H/sub j/^{0} is relatively easy to find if one of the Higgs bosons decays into a muon pair (and probably if it decays into a tau pair) and if the suppression of the cross section due to the Higgs mixing is not too severe. Possible strategies to find these events are discussed, and some of them are demonstrated. Higgs bosons from top quark decay are also briefly discussed. 36 references, 22 figures.

23439 (SLAC—315, pp 317-330) **Searches for supersymmetric particles.** Barklow, T. Jul 1987. NTIS, PC A 14. Order Number DE88002997/JAW. (CONF-870298—).

From 3. MARK II workshop on SLC physics; Watsonville, CA, USA (25 Feb 1987).

The author should be able to exclude with the MARK II a very large fraction of the kinematically accessible SUSY particles predicted by the minimal SUSY extension to the standard model. If there is a SUSY particle being produced, they should be able to prove that the Z^0 is decaying to a new particle with SUSY-like properties. They also believe that they are in a very good position to extract many of the properties of such a particle. 4 references.

23440 (SLAC—315, pp 332-353) **Small multiplicity events in $e^+ + e^- \rightarrow Z^0$ and unconventional.** Perl, M.L. Jul 1987. NTIS, PC A 14. Order Number DE88002997/JAW. (CONF-870298—). Contract AC03-76SF00515.

From 3. MARK II workshop on SLC physics; Watsonville, CA, USA (25 Feb 1987).

Events with two-, four- or six-charged particles and no photons produced through the process $e^+ + e^- \rightarrow Z^0$ provide an opportunity to search for unconventional phenomena at the SLC and LEP electron-positron colliders. Examples of unconventional processes are compared with the expected background from electro-

magnetic processes and from charged lepton pair production. 16 references, 8 figures, 1 table.

23441 (SLAC—315, pp 354-369) **Single quark decays in toponium.** Ward, B.F.L. Jul 1987. NTIS, PC A 14. Order Number DE88002997/JAW. (CONF-870298—).

From 3. MARK II workshop on SLC physics; Watsonville, CA, USA (25 Feb 1987).

The authors consider single quark decays in toponium from the standpoint of the physics possibilities for the MkII detector at the SLC. Three types of estimates are considered: nonrelativistic potential model estimates, vector dominance model estimates, and Lepage-Brodsky perturbative QCD estimates. They argue that the difference between the estimates may be traced to the large squared momentum behavior of the respective wavefunctions of the T/sub b/* meson. Thus, the MkII, operating at the SLC, may be able to discriminate between these wavefunctions. 6 references, 5 figures, 1 table.

23442 (SLAC—315, pp 370-378) **View from the top(onium).** Sadrozinski, H.F.W. Jul 1987. NTIS, PC A 14. Order Number DE88002997/JAW. (CONF-870298—).

From 3. MARK II workshop on SLC physics; Watsonville, CA, USA (25 Feb 1987).

In the framework of the MARK II/SLC Physics Workshop, they investigated toponium physics topics which could be relevant in the early running of SLC: the duration of a toponium run and the luminosity will be limited and basically they confined themselves to physics with 1000 toponium events. At a luminosity of L = 10^{30} cm^{-2} sec^{-1} and an energy spread of σ E/sub CM/ = 0.0008 E/sub CM/ this could be accomplished in 3 months. The physics topics relevant to such a small data sample are discussed in the second part. The third part will be devoted to toponium searches. They conclude with a critical assessment of their assumptions. 10 references, 4 figures.

23443 (SLAC—315, pp 401-458) **QCD at the Z^0.** Petersen, A. Jul 1987. NTIS, PC A 14. Order Number DE88002997/JAW. (CONF-870298—).

From 3. MARK II workshop on SLC physics; Watsonville, CA, USA (25 Feb 1987).

This report summarizes the work of the QCD group as it was presented at the Mark II Pajaro Dunes Workshop. The QCD working group has in principle to cover a large variety of topics addressed by multihadronic events on the Z^0. A lot of the points are not directly related to the production and decay of the Z^0, rather to the new energy range opened up by the SLC or LEP. The large hadronic cross section on the Z^0 will possibly provide them with quite enormous event samples compared to the cross section in the continuum. On the other hand, events from standard QCD predictions will be the background to possible new physics at energies near the Z^0 mass.

23444 (SLAC—315, pp 379-400) **Detection and identification of (long lived) neutral particles.** Klein, S. Jul 1987. NTIS, PC A 14. Order Number DE88002997/JAW. (CONF-870298—).

From 3. MARK II workshop on SLC physics; Watsonville, CA, USA (25 Feb 1987).

This report summarizes work done by the Mark II/Upgrade Working Group on long lived neutral particles. The group explored a variety of models which postulate the production of one or more neutral particles. They focused on models where the neutrals were long lived, producing separated vertices. Most of the work was based on a model of neutral heavy lepton pair production, but much of it could be easily adapted to other models of long lived particle production. The topics discussed are: physics models, triggering problems, tracking and reconstruction difficulties, backgrounds, and neutral heavy lepton identification. 7 references, 17 figures, 3 tables.

23445 (SLAC—315, pp 459-472) **Psi tagging and B spectroscopy.** Wormser, G. Jul 1987. NTIS, PC A 14. Order Number DE88002997/JAW. (CONF-870298—).

From 3. MARK II workshop on SLC physics; Watsonville, CA, USA (25 Feb 1987).

One of the most interesting aspects of standard physics on the Z^0 peak is precision measurements of B spectroscopy. Two very challenging results are missing now, namely the separate measurement of B/sub d/° and B^- lifetimes and exclusive reconstruction of B/sub s/°. In this note, a simple and powerful way to obtain these results is described, the psi tagging. Some simple ideas are developed in Section 1. Section 2 is devoted to a search for psi events in the PEP data, in order to get a feeling of the feasibility of such a method and Section 3 contains the extrapolated results expected at SLC. Although this method will be shown one of the most effective to reach the above goals, it requires however a large amount of Z^0 events. This physics begins in fact with 100 to 200 thousand Z^0 events (the expected final sample of MarkII) to reach its full strength with 1 million Z^0 (a typical LEP luminosity). Thus, in 3 years from now, it is highly probable that the above goals will be reached, since there is almost no unknown parameters in this method. 5 references, 7 figures, 1 table.

23446 (SLAC—315, pp 473-482) **Vertex tagging of b quarks and the $Z^0 \rightarrow$ b fraction.** Weber, P. Jul 1987. NTIS, PC A 14. Order Number DE88002997/JAW. (CONF-870298—).

From 3. MARK II workshop on SLC physics; Watsonville, CA, USA (25 Feb 1987).

$Z^0 \rightarrow$ b anti b events are selected with a method that examines the impact parameter significances of charged tracks in an event. Using this efficient selection technique, and good Monte Carlo simulations, one can model the branching fraction of $Z^0 \rightarrow$ b quarks. The effectiveness of this method has been examined with Monte Carlo data that include the new drift chamber vertex detector simulation package. 4 references, 2 figures, 2 tables.

23447 (SLAC—315, pp 483-499) **Measurement of the bottom quark lifetime.** Ford, W.T. Jul 1987. NTIS, PC A 14. Order Number DE88002997/JAW. (CONF-870298—).

From 3. MARK II workshop on SLC physics; Watsonville, CA, USA (25 Feb 1987).

The quark mixing matrix is constrained by the lifetime of the bottom quark, the off-diagonal elements involving the b quark being completely determined by the lifetime and the branching ratio between the decays b $\rightarrow$ u and b $\rightarrow$ c. If the binding of the b quark into hadrons has no effect on its decay rate, the inclusive lifetime measurement discussed here reflects precisely the quark total decay rate. Their experience with charmed hadrons serves to warn that the situation may not be so simple, and they are eager to find techniques for determining the lifetimes of individual hadron states, particularly the mesons B^+, B/sub d/° and B/sub s/°. The subject of this note, however, is a detailed evaluation of prospects for improving the inclusive measurement, as it has been performed at PEP and PETRA, based upon the impact parameter distribution of leptons from the b hadron semileptonic decays. This note supersedes intermediate reports from the Asilomar and Granlibakken meetings. The first two sections are based mainly upon studies with Monte Carlo generated quantities in which they explore the kinematics of bottom particle semileptonic decays to develop event selection criteria and measure sensitivity of the impact parameter to the lifetime and to the details of particle production. Detector effects are considered in section 3, data reduction in sections 4 and 5, and conclusions in section 6. 6 references, 11 figures, 1 table.

23448 (SLAC—315, pp 500-516) **Inclusive leptons and B^0-anti B^0 mixing at SLC.** Coupal, D.P. Jul 1987. NTIS, PC A 14. Order Number DE88002997/JAW. (CONF-870298—).

From 3. MARK II workshop on SLC physics; Watsonville, CA, USA (25 Feb 1987).

The Mark II detector is well suited for the study of leptons from the weak decays of heavy quarks. This note presents the Monte Carlo results of a study of inclusive lepton rates done in the b and c quark working group. These results are an extension of those of an earlier study M. Nelson. The single lepton rates, determined from Monte Carlo, will be used to predict the same sign dilepton rates from B^0-anti B^0 mixing. Earlier studies of inclusive leptons at SLC used Monte Carlo generated 4-vectors with approximations of the misidentification probabilities for electrons in the liquid argon calorimeter and drift chamber dE/dx and muons in the

muon detector. This study used Monte Carlo generated raw data including simulated dE/dx data. Work on modeling lepton identification in the calorimeters and muon detector is still in progress - results from previous studies will be used here. 9 references, 6 figures, 4 tables.

23449 (SLAC—315, pp 517-534) **B and c quark exclusive decays with the vertex detector.** Hayes, K. Jul 1987. NTIS, PC A 14. Order Number DE88002997/JAW. (CONF-870298—).

From 3. MARK II workshop on SLC physics; Watsonville, CA, USA (25 Feb 1987).

Physics topics as diverse as the forward backward charge asymmetry to CP violation can be studied with the aid of heavy quark exclusive decays at the Z^0. The Mark II with its vertex detector is sufficiently powerful to do a good job on many of these topics with reasonable acceptances and sample purities. Measurements of the absolute value of V/sub bu/ using $B^0 \rightarrow \pi^+\pi^-$ and of the B^0 lifetime using the decay $B^0 \rightarrow D^+ + l^- +$ neutrals ($D^+ \rightarrow K^-\pi^+\pi^+$) have been illustrated in this paper. Unfortunately, given the small branching ratios for most exclusive decay modes, large numbers of Z^0 decays are needed. From the standpoint of vertex detector performance, the Mark II vertex detector can fully reconstruct the vertex topology of nearly all strange particle decays, but in general can only tag the presence of secondary b and c quark decay vertices with good efficiency. High efficiency full vertex reconstruction of heavy quark decays requires an order of magnitude improvement in impact parameter resolution. Analyses which use vertex detector information to make vertex topology cuts for b and c quark decay will have good efficiency if significant impact parameters ($\delta/\sigma > 3$) are required for only a few tracks. 7 references, 6 figures.

23450 (SLAC—315, pp 535-545) **Single γ background to neutrino counting from radiative Bhabha scattering.** Karlen, D. Jul 1987. NTIS, PC A 14. Order Number DE88002997/JAW. (CONF-870298—).

From 3. MARK II workshop on SLC physics; Watsonville, CA, USA (25 Feb 1987).

Neutrino counting experiments attempt to measure the single γ cross section from the process, $e^+e^- \rightarrow$ nu anti nu γ to determine the number of light neutrino species. The major background to this process is from radiative Bhabha scattering, $e^+e^- \rightarrow e^+e^-\gamma$ where both electrons escape detection at low angles. This background can be eliminated if the observed single photon is required to have sufficient transverse momentum so as to force an electron into the detector acceptance. Such a requirement significantly reduces the signal, especially when the center of mass energy is near M/sub Z^0/. If the background from radiative Bhabha scattering is small and well understood, it would be possible to relax this requirement. In this talk, the author will discuss calculations of this background to order a^3 and a^4, and compare results from a Monte Carlo event generator with data from the MarkII and ASP experiments. 5 references, 9 figures, 3 tables.

23451 (SLAC—315, pp 546-577) **Report from the neutrino counting group.** Bonvicini, G.; Barnett, B.; Briggs, D.; Burke, D.; Cence, R.; Fernandez, D.; Gero, E.; Gidal, G.; Grosse Wiesmann, P.; Haggerty, J.; Harris, F. Jul 1987. NTIS, PC A 14. Order Number DE88002997/JAW. (CONF-870298—).

From 3. MARK II workshop on SLC physics; Watsonville, CA, USA (25 Feb 1987).

The status of the work on measuring the number of neutrinos is reviewed. They discuss the importance of detecting and isolating single-photon events as a unique way of measuring the decay width of the Z to an undetectable final state. They describe in detail the necessary hardware and software requirements, and the efforts made by the MKII Collaboration to provide a hermetic detector with high trigger efficiency for single photons. The status of the theoretical work on radiative corrections is also discussed. Conclusions are presented with regard to luminosity and energy requirements for a definitive single-photon experiment. 21 references, 15 figures, 2 tables.

23452 (SLAC-PUB—4503) **Recent measurements of the B hadron lifetime.** Ong, R.A. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Dec 1987. Contract AC03-76SF00515. 14p. (CONF-870821—8). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005876/JAW.

From SLAC summer institute on particle physics; Stanford, CA, USA (10 Aug 1987).

Recent measurements of the B hadron lifetime from PEP and PETRA experiments are presented. These measurements firmly establish that the B lifetime is long (~1 psec), implying that the mixing between the third generation of quarks and the lighter quarks is much weaker that the mixing between the first two generations.

23453 **Limits on new fermions from pp-bar collider data.** Rizzo, T.G. (Ames Lab., and Dept. of Physics, Iowa State Univ.). *Modern Physics Letters A;* 2: No. 7, 505-512(Jul 1987). Contract FG05-85ER40200.

Recent data from the UA2 Collaboration is used to place new limits on the top quark mass as well as hypothetical new fermions such as additional light neutrinos, a fourth generation charged lepton L, a fourth generation Q = -1/3 down-type quark b', as well as the Q = -1/3, isosinglet E/sub 6/ exotic quark D.

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REFER ALSO TO CITATION(S) 23416, 23453, 23485, 23495

23454 (EFI—925(76)-86) **Planar quark diagrams and binary spin processes.** Grigoryan, A.A.; Ivanov, N.Ya. (Erevanskij Fizicheskij Inst. (USSR)). 1986. 26p. NTIS (US Sales Only), PC A03/MF A01. Order Number TI88701550/JAW.

Contributions of planar diagrams to the binary scattering processes are analyzed. The analysis is based on the predictions of quark-gluon picture of strong interactions for the coupling of reggeons with quarks as well as on the SU(6)-classification of hadrons. The dependence of contributions of nonplanar corrections on spins and quark composition of interacting particles is discussed. 25 refs.; 6 figs.

23455 (EFI—930(81)-86) **Quark-gluon mixing in scalar mesons.** Eremyan, Sh.S.; Nazaryan, A.E. (Erevanskij Fizicheskij Inst. (USSR)). 1986. 28p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700969/JAW.

Scalar mesons are considered within the quark-gluon mixing model. It is shown that there exists decouplet of scalar particles consisting of S* (975), ϵ (1400), S*' (1700), δ (980) and κ (1350) resonances. It has turned out that the long ago known S* (975)-resonance is a nearly pure glouball. A good description of all available experimental data on scalar meson decays is obtained. 21 refs.; 2 tabs.

23456 (EFI—931(82)-86) **Quark-gluon mixing and inclusive spectra of pseudoscalar and tensor mesons.** Badalyan, R.G.; Nazaryan, A.E. (Erevanskij Fizicheskij Inst. (USSR)). 1986. 26p. NTIS (US Sales Only), PC A03/MF A01. Order Number TI88701552/JAW.

With regard for quark-gluon mixing in pseudoscalar eta, eta', i(1440) and tensor f, f', Θ(1690) mesons are obtained their inclusive spectra in the fragmentation region of proton, pion and kaon within the framework of multiparton recombination model. The obtained results give the possibility of an experimental verification if i(1440) and Θ(1690) are glueballs. 17 refs.; 6 figs.

23457 (FNAL/Pub—88/14) **CP-violating lepton asymmetry due to B-anti B mixing.** Altomari, T.; Wolfenstein, L.; Bjorken, J.D. (Carnegie-Mellon Univ., Pittsburgh, PA (USA). Dept. of Physics; Fermi National Accelerator Lab., Batavia, IL (USA)). Jan 1988. Contract AC02-76CH03000. 16p. (CMU-HEP—87-27). NTIS, PC A03. Order Number DE88006279/JAW.

As a result of B-B mixing associated production of B-B pairs yields like-sign lepton pairs when both B's decay semi-leptonically.

Formulas are given for the CP violating charge asymmetry of these like-sign pairs. It is argued that previous calculations based on quark diagrams are unreliable and that the asymmetry might be considerably larger. It is concluded that a reasonable estimate of the asymmetry lies between 10^{-3} and 10^{-2}, but neither the sign nor the magnitude can be reliably calculated.

23458 **(IFUSP-P—626) Gentilionic theory for quarks: Manifestly confining for quarks and manifestly non-coalescent for hadrons.** Cattani, M.S.D. (Sao Paulo Univ. (Brazil). Inst. de Fisica). Jan 1987. 16p. NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701581/JAW.

It's shown that the gentilionic theory for quarks is manifestly confining for quarks and manifestly non-coalescent for hadrons, and that these properties are rigorously deduced only from first principles. To prove them no arguments involving the intrinsic nature of gentileons or dynamical hypothesis are necessary to be adopted. It's also shown that, in the context of the quantum field theory, gentileous can be taken approximately as fermions and that the usual quantum chromodynamics can be used to calculate the properties of gentilionic hadrons.

23459 (INIS-BR—917, pp 17) **Twin Higgs-boson production.** Eboli, O.J.P.; Marques, G.C.; Novaes, S.F.; Natale, A.A. (Sao Paulo Univ., Brazil. Inst. de Fisica; Instituto de Fisica Teorica, Sao Paulo, Brazil). 1987. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701458/JAW. (CONF-8709236—).

From 8. national meeting of particle physics and fields; Caxambu, MG, Brazil (16 Sep 1987).

23460 (INIS-BR—917, pp 12) **Radiative decay of hyperons: Fermilab E-761.** Escobar, C.O. (Sao Paulo Univ., Brazil. Inst. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701458/JAW. (CONF-8709236—).

From 8. national meeting of particle physics and fields; Caxambu, MG, Brazil (16 Sep 1987).

23461 (INIS-BR—917, pp 16) **Pp and p-bar p elastic scattering at 53 Gev and pp-bar at the collider region and the Chou-Yang model.** Padua, A.B. de; Pimentel, B.M.; Bellandi Filho, J.; Menon, M.J.; Covolan, R.J.M.; Brunetto, S.Q. (Universidade Estadual de Londrina, Brazil; Universidade Estadual de Campinas, Brazil. Inst. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701458/JAW. (CONF-8709236—).

From 8. national meeting of particle physics and fields; Caxambu, MG, Brazil (16 Sep 1987).

23462 (INIS-BR—917, pp 16) **Joint analysis of the elastic reactions PI+p, K/sup +/p and pp at 50Gev/c and PI/sup -/p,pp at 200 Gev/c with the Chou-Yang model.** Pimentel, B.M.; Bellandi Filho, J.; Menon, M.J.; Covolan, R.J.M.; Brunetto, S.Q. (Universidade Estadual de Campinas, Brazil. Inst. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701458/JAW. (CONF-8709236—).

From 8. national meeting of particle physics and fields; Caxambu, MG, Brazil (16 Sep 1987).

23463 (INIS-BR—917, pp 16) **Truncated compound Poisson (TPC) alternative to multiplicity distribution in hadron-hadron collisions (UA5 and NA22 collaboration data).** Srivastava, P.P. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1987. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701458/JAW. (CONF-8709236—).

From 8. national meeting of particle physics and fields; Caxambu, MG, Brazil (16 Sep 1987).

23464 (INIS-BR—917, pp 17) **Gluonium spin structure.** Carvalho, H.F. de; Castro, A.S. de; Antunes, A.C.B. (Rio de Janeiro Univ., Brazil. Inst. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701458/JAW. (CONF-8709236—).

From 8. national meeting of particle physics and fields; Caxambu, MG, Brazil (16 Sep 1987).

23465 (INIS-BR—917, pp 17) **Charge multiplicity in high-energy hadronic reactions.** Reis, A.C. dos; Kodama, T. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1987. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701458/JAW. (CONF-8709236—).

From 8. national meeting of particle physics and fields; Caxambu, MG, Brazil (16 Sep 1987).

23466 (INIS-BR—917, pp 18) **Consequence of the nuclear interactions inelastic cross section increasing on the hadronic and electromagnetic components flux of the cosmic radiation.** Portella, H.M. (Universidade Federal Fluminense, Niteroi, Brazil. Inst. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701458/JAW. (CONF-8709236—).

From 8. national meeting of particle physics and fields; Caxambu, MG, Brazil (16 Sep 1987).

23467 (INIS-BR—934, pp 79) **EMC (Europeam Muon Collaboration) effect current status.** Gattone, A.O. (Comision Nacional de Energia Atomica, Buenos Aires, Argentina). 1987. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701471/JAW. (CONF-8708216—).

From 10. workshop on nuclear physics in Brazil; Caxambu, MG, Brazil (26 Aug 1987).

23468 **(ITEP—3(1986)) Interpretation of resonances found in the $\gamma\gamma$ system as four-quark states.** Badalyan, A.M.; Ioffe, B. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1986. 7p. NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701644/JAW.

It is argued that the 2.2-2.4 GeV resonances recently found experimentally in the phiphi system are four-quark states S-barS-barSS of two strange quarks and two strange antiquarks. 10 refs.; 2 figs.

23469 **(ITEP—21(1986)) Difficulties with interpretation of underground muons from Cygnus X-3.** Berezinskij, V.S.; Ellis, J.; Ioffe, B.L. (AN SSSR, Moscow. Inst. Yadernykh Issledovanij; European Organization for Nuclear Research, Geneva (Switzerland); Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1986. 27p. NTIS (US Sales Only), PC A03/MF A01. Order Number TI88701645/JAW.

A possibility are analysed to explain the underground muon flux detected from Cygnus X-3, using new particles (cygnets). The following constraints on the cygnet properties are obtained: on the life-time tau>1.3x10/sup 6/ (Γ/10/sup 6/)s where Γ is the cygnet Lorentz factor, on the mass, m<5.7 (E/100 TeV)GeV where E is the cygnet energy, on the electric charge Q<2.10/sup 7/e and on the mean scattering angle (due to an arbitrary process) on the way from Cygnus X-3 to the Sun Θ<4.10/sup -3/ grad. It is shown that the NUSEX data (the angular spread of muons within 10/sup 0/ x10/sup 0/ box of observation and the dependence of the Cygnus X-3 exposition time on the depth of the matter along the observation line) contradict muon generation in the atmosphere and require muon generation in the ground. These data determine narrow boundaries for the cygnet-nucleon interaction cross section 2μb<σ<10μb. The cross section low limit for the cygnet production in reaction pp->CX is obtained from a constraint on the flux of underground muons generated by neutrinos: σ(pp->CX)>10(E/sub c//1TeV)/sup 1.1/μb where E/sub c/ is the energy of cygnets responsible for the muon flux observed by NUSEX. 40 refs.; 2 figs.

23470 (ITEP—82(1986)) Neutrino electrodynamics and possible effects for solar neutrinos. Okun', L.V.; Voloshin, M.V.; Vysotskij, M.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1986. 26p. NTIS (US Sales Only), PC A03/MF A01. Order Number TI88701647/JAW.

The matrix of electromagnetic moments of neutrinos and the possibility that some of the moments are as large as of the order of 10/sup -10/ of the Bohr magneton are discussed. Oscillations between neutrino flavors as well as neutrino spin precession in the presence of matter are considered. An interaction of solar neutrinos with the magnetic field existing in the convective zone inside the Sun could give rise to the 11-year and semiannual cycles of variation of the measured solar neutrino flux in correlation with the solar activity. 27 refs.

23471 (ITEP—126(1985)) Probing the six - quark bag in the low - energy np->Dγ capture. Grach, I.; Shmatikov, M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1985. 23p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87702948/JAW.

The circular polarization P/sub γ/ of γ-quanta radiated in the capture of polarized thermal neutrons by protons is discussed. The contributions to P/sub γ/ coming form radiation of nucleons, meson-exchange currents and quarks in a six-quark bag are calculated. The value of P/sub γ/ proves to be rapidly varying function of the radius r_0 of the six-quark bag. Comparison to the experimental value of P/sub γ/ yields $r_0 \simeq 1.0+1.3$ F. 20 references, 4 figures, 1 table.

23472 (ITEP—131(1985)) Structure functions of deep inelastic scattering in the region of intermediate x in QCD. Ioffe, B.L. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1985. 7p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87702949/JAW.

The valence quark contribution to structure function of deep inelastic νp scattering in the region of intermediate x and $Q^2=5$-20 GeV^2 (where $x=Q^2/2\nu$, Q^2 is the momentum square transferred to hadron, $Q^2=-q^2$, ν/m is the transferred energy, m is the hadron mass), i.e. the distribution of valence d quarks in proton d/sub V/(x), is calculated in QCD. The results of the calculations without any fitting parameters are in agreement with experiment. 8 references, 4 figures.

23473 (ITEP—157(1985)) Production of charm in the quark-gluon strings model. Kajdalov, A.V.; Piskunova, O.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1985. 22p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87702950/JAW.

The quark-gluon strings model based on the 1/N/sub f/ - expansion in QCD is applied to the production of the charmed particles D(D-bar)-mesons and Λ/sub c/$^+$-hyperons. It is demonstrated that the model describes quantitatively the basic characteristics of the inclusive charm production generation. Experimental data indicate to the nonlinearity of the PSI-mesons Regge trajectory with a close to zero intercept (α/sub PSI/(0) — 0). The model predictions for the inclusive spectra of the charmed particles are given in a wide energy range. 20 references, 6 figures.

23474 (JINR-E—2-86-790) QCD vacuum effect on hadron electromagnetic mass differences. Dorokhov, A.E.; Kochelev, N.I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics; AN Kazakhskoj SSR, Alma-Ata. Inst. Fiziki Vysokikh Ehnergij). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1986. 7p. NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701657/JAW.

Submitted to the journal Z. Phys., C.

Electromagnetic splitting of hadron masses have been calculated in a combined model taking account of the interaction with QCD vacuum condensates. Total mass difference is determined with the contribution sum: electromagnetic quark interaction, dependence of kinetic quark energy on their mass difference and with the effect of quark mass difference on strong interaction potential. It is shown that taking account of the quark interaction with QCD vacuum permits to satisfactorily describe experimental data. Difference of U and d quark masses: m/sub d/-m/sub u/=3.7 MeV - has been estimated. 16 refs.; 1 tab.

23475 (JINR-E—2-87-74) Diquarks role in large-p/sub t/ deuteron and H-dihyperon production in hard nucleon collisions. Efremov, A.V.; Kim, V.T. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 7p. NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701658/JAW.

Submitted to the journal Phys. Lett. .

A new mechanism of large-p/sub tr/ deuteron and H-dihyperon production in nucleon collisions by simultaneous double quark-diquark scattering is proposed. A good description of data on anomalous large-p/sub tr/ deuteron production obtained in Serpukhov is presented. For testing the proposed mechanism the measurement of production cross section of nonsymmetric proton pairs (ν/sub cm/=90 deg, PHI not = 180 deg) with identical p/sub tr/ in pp collisions is needed. 21 refs.; 3 figs.

23476 (JINR-E—2-87-75) Diquarks as a source of large-P/sub t/ baryons in hard nucleon collisions. Kim, V.T. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 7p. NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701659/JAW.

Submitted to the journal Phys. Lett. .

The production of nucleons, symmetric nucleon pairs, and Λ/sup 0/ hyperons with large P/sub tr/ in pp-collisions is discussed in the framework of a dominating scalar (ud)-diquark nucleon model. The necessity of making allowance for higher twists-diquarks for explaining strong scaling breaking in p/π/sup +/ ratio is shown. The approximate equation Λ/p ≃ k/sup +//π/sup +/ is predicted in this model. 34 refs.; 2 figs.

23477 (JINR-R—1-86-617) Inclusive spectra of secondary particles in πpp and π$^-$C interactions at P=40 GeV/c and quark-gluon string model. Grishin, V.G.; Didenko, L.A.; Metreveli, Z.V.; Shabel'skij, Yu.M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1986. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87702975/JAW.

Submitted to the journal Sov. J. Nucl. Phys.

The experimental data on hadron production in π$^-$p and π$^-$^{12}C interactions at 40 GeV/c are compared with the calculations within the quark-gluon string model describes well the π/sup +-/-, K^0- and Λ-particle distributions over x/sub F/ variable in c.m.s. forward hemisphere. 14 references, 4 figures.

23478 (JINR-R—2-86-167) Upper limits for quarkonium radiative decay probabilities in the relativistic theory of bound states. Savrin, V.I.; Shichanin, S.A.; Skachkov, N.B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1986. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87702978/JAW.

On the basis of three-dimensional quasipotential approach to the problem of relativistic description of bound states formulae are derived that express the widths of radiative decay of vector and pseudoscalar mesons through the relativistic wave functions of bound states of two quarks. With the use of the normalization conditions for the wave functions and Cauchi-Bunyakovsky relation (without any assumptions about the form of the quasipotential of quark interaction and the form of the wave functions) for a set of known vector and pseudoscalar mesons the upper limits for radiative-decay widths (V -> γP and P -> γV) are found most of which turn out to be predictions of the theory. 8 references, 1 table.

23479 (JINR-R—2-86-297) Gluon dominance and multihadron production. Kalinkin, B.N.; Shmonin, V.L. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1986. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87702979/JAW.

Interpretation is given of basic regularities of the multihadron production in hadron collisions in the framework of the model of two-gluon fusion. Requirements are formulated for the behaviour of the cross section of such a fusion following from the analysis of the production process. Consistency of these requirements with the idea of stochastization of the motion in nonlinear dynamic systems is discussed. 22 references, 2 figures.

23480 (NIKHEF-H—87-5) Note on Fujikawa's method of determining the critical dimension of the relativistic string. Petcher, D.N.; Holten, J.W. van. (Nationaal Inst. voor Kernfysica en Hoge-Energiefysica (NIKHEF), Amsterdam (Netherlands). Sectie H). Apr 1987. 5p. NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701771/JAW.

Fujikawa's derivation of the critical dimension of the relativistic string in the path integral formulation is reconsidered. It is shown that the correct prescription for choosing the functional measure is obtained by requiring standard BRST-invariance without modifications and that Fujikawa's choice of measure is not unique. We find a one-parameter family of BRST-invariant measures even after fixing a gauge for local Weyl rescalings. Gauge independence of the resulting theory is demonstrated in the critical number of dimensions. 13 refs.

23481 (NIKHEF-H—87-10) Hadronic overlap and total multiplicity distributions in high energy physics collisions. Wolters, G.F. (Nationaal Inst. voor Kernfysica en Hoge-Energiefysica (NIKHEF), Amsterdam (Netherlands). Sectie H). Jun 1987. 51p. NTIS (US Sales Only), PC A04/MF A01. Order Number TI88701774/JAW.

In the realm of Chou and Yang's geometrical description of hadron collisions at high energy, the total multiplicity distribution of negative binomial type for non-leading secondaries is compounded from a Poisson and a gamma distribution. The latter is attributed to overlap in space-time of the colliding hadrons. The overlap is defined here in terms of local interaction probabilities for each incident hadron. These probabilities are assumed to be similar but not identical to hadron constituent quark densities. They are predicted to approach the densities for growing energy. This as well as the resulting integrated overlap are borne out by the empirical data on the negative binomial distribution in an unambiguous way. The preponderance of the latter at very high energies thus reflects non-relativistic spatial hadron structure and incoherence of event-like excitations throughout the overlap region. 9 refs.; 6 figs.

23482 (RRK—86-18) D^0 -> phiK-bar^0 decay in the algebraic approach to non-leptonic weak decays. Terasaki, K.; Oneda, S. (Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics). May 1986. 22p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703022/JAW.

Contrary to the expectation of naive spectator model, D^0 -> phiK-bar^0 decay has recently been observed with appreciable branching ratio. In this paper, it is however pointed out that the sizable rate of D^0 -> phiK-bar^0 decay is, in fact, no surprise in the newly developed algebraic approach to non-leptonic weak interactions and it can be estimated from the well-known rate of K/sub S/ -> 2π decays. The value of $\Gamma(D^0$ -> phiK-bar$^0)$ thus obtained is in good agreement with experiments. The approach uses hard PS-meson extrapolation instead of soft one and deals with long distance physics in earnest, by using the algebraic method developed in the framework of asymptotic flavor symmetry which neverthless maintains a close connection with quark-line diagrams.

23483 Final state interaction in K/sup 0/ decay. Brown, G.E.; Johnson, M.B.; Speth, J. (State Univ. of New York, Stony Brook, USA; Los Alamos National Lab., NM, USA; Kernforschungsanlage Juelich G.m.b.H., Germany, F.R. Inst. fuer Kernphysik). *Verhandlungen der Deutschen Physikalischen Gesellschaft;* **23**: No. 6, F9.5(Mar 1988). (CONF-880347—).

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23484 Neutral-pion photoproduction on protons near threshold. Davidson, R.; Mukhopadhyay, N.C. (Physics Department, Rensselaer Polytechnic Institute, Troy, New York 12180-3590). *Physical Review Letters;* **60**: No. 8, 748-748(22 Feb 1988).

A Comment on the Letter by E. Mazzucato et al., Phys. Rev. Lett. 57, 3144 (1986).

6453 Particle Invariance Principles And Symmetries

REFER ALSO TO CITATION(S) 23491, 23494, 23671

23485 (CERN-EP—87-24) Supersymmetric particles search at LEP 200. Grivaz, J.F.; Mallet, V.; Bianchi, F.; Boratav, M.; Geara, C.; Carminati, F.; Dionisi, C.; Gratta, G.; Luminari, L.; Maire, M. (European Organization for Nuclear Research, Geneva (Switzerland)). 11 Feb 1987. 35p. (CONF-8609223—8). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88900434/JAW.

From ECFA workshop: LEP 200; Aachen, F.R. Germany (29 Sep 1986).

The Large Electron Positron (LEP) collider being built at CERN, after its first phase of operation at a center of mass energy $\sqrt{s}$ = M/sub z/o (LEP I), is expected to have its energy increased beyond the W -pairs production threshold to about 100GeV in each beam with a peak luminosity of $L = 0.5 \times 10^{32} cm^{-2} s^{-1}$ (LEP II or LEP 200). In this report we present the results of a detailed search for supersymmetric particles at $\sqrt{s}$ = 190GeV where the W^+W^- production has its maximum σ/sub tot/$(W^+W^-) \simeq$ 17pb. We review for all the reactions studied how far LEP 200 can push the SUSY mass limits also in comparison with limits expected from other machines like the FNAL Tevatron and HERA. 23 refs., 19 figs., 12 tabs.

23486 (EFI—941(92)-86) Superunification model SO(10). Asatryan, G.M.; Ionnisyan, A.N. (Erevanskij Fizicheskij Inst. (USSR)). 1986. 20p. NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701555/JAW.

A superunification model based on SO(10) group is proposed. The supersymmetry and the intermediate symmetry SU(3)/sub c/xU(1)/sub B-L/xSU(2)/sub R/xSU(2)/sub L/ are broken by means of one scale parameter. The superpartners of ordinary particles obtain masses due to account of quantum corrections. The electroweak group breaking is also achieved after taking the quantum corrections to masses of scalar SU(2)/sub L/ doublets into account. A relation is obtained which connects the t-quark and the fermion superpartners masses if: the t-quark mass is 40 GeV; the superpartner masses are in the region of 150-180 GeV. The obtained relation for the masses of the superpartners of gauge bosons can be useful for estimations of the proton lifetime. 18 refs.

23487 (INIS-BR—934, pp 80) Three-axis in IBM. Nunes, C.A.; Lima, C.L. 1987. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701471/JAW. (CONF-8708216—).

From 10. workshop on nuclear physics in Brazil; Caxambu, MG, Brazil (26 Aug 1987).

23488 (LAFI—107) Kinks at structural phase transitions in systems with multicomponent order parameter. Kashcheev, V.N. (AN Latvijskoj SSR, Riga. Inst. Fiziki). 1987. 22p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701690/JAW.

1+1-dimensional kink-type solutions have been derived for the Landau-Khalatnikov equations describing critical relaxation of the structural order parameter (SOP). The following cases are considered: 1) a one-component SOP, free energy F contains invariants of the 4, 6, 8 orders; 2) two-component SOP, F contains invariants of the 4 order (the cubic and Lifshits ones including); 3) a three-component SOP, F contains invariants of the fourth order. At T=T/sub 0/, in case the coefficient of the second order invariant for F is zero, the solutions derived become singular. 21 refs.

23489 (RRK—86-22) Equivalence of degenerate (super) conformal models. Yamanaka, I. (Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics). May 1986. 23p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703026/JAW.

The equivalence among the energy-momentum tensors of degenerate (super) conformal models made of fermions is shown. By this correspondence, a nonmanifest super current is revealed.

6454 Field Theory

REFER ALSO TO CITATION(S) 23443, 23484

23490 (BONN-HE—87-18) Finite lattice extrapolation algorithms. Henkel, M.; Schuetz, G. (Bonn Univ. (Germany, F.R.). Physikalisches Inst.). Aug 1987. 25p. NTIS (US Sales Only), PC A03/MF A01. Order Number TI88752462/JAW.

Two algorithms for sequence extrapolation, due to von den Broeck and Schwartz and Bulirsch and Stoer are reviewed and critically compared. Applications to three states and six states quantum chains and to the (2+1)D Ising model show that the algorithm of Bulirsch and Stoer is superior, in particular if only very few finite lattice data are available.

23491 (DESY—87-003) Representation theory of the symmetry group of lattice fermions as a basis for kinematics in lattice QCD. Joos, H.; Schaefer, M. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Jan 1987. 26p. Also published in Z. Phys., C (May 1987) v. 34(4) p. 465-480.

The symmetry group of staggered lattice fermions is discussed as a discrete subgroup of the symmetry group of the Dirac-Kaehler equation. For the representation theory of this group, G. Mackey's generalization of E.P. Wigner's procedure for the construction of unitary representations of groups with normal subgroups is used. A complete classification of these irreducible representations by "momentum stars", "flavour orbits" and "reduced spins" is given.

23492 (DESY—87-012) On the nuclearity condition for massless fields. Buchholz, D.; Jacobi, P. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.); Hamburg Univ. (Germany, F.R.). 2. Inst. fuer Theoretische Physik). Feb 1987. 20p. Also published in Lett. Math. Phys. (May 1987) v. 13(4) p. 313-323.

It is shown that quantum field theories of free massless particles satisfy a recently proposed 'nuclearity condition' restricting the admissible number of local degrees of freedom of a theory. This result is based on an improved bound for the 'nuclearity index' of certain specific sets of vectors in Fock space.

23493 (DESY—87-017) Scaling laws and triviality bounds in the lattice PHI/sup 4/ theory. Pt. 1. One-component model in the symmetric phase. Luescher, M.; Weisz, P. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.); Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.); Hamburg Univ. (Germany, F.R.). 2. Inst. fuer Theoretische Physik). Mar 1987. 69p. Also published in Nucl. Phys., B - Field Theory Stat. Syst. (28 Sep 1987) Vol. 290(1) p. 25-60.

The lattice PHI/sup 4/-theory in four space-time dimensions is most likely 'trivial', i.e. its continuum limit is a free field theory. However, for small but positive lattice spacing 'a' and at energies well below the cutoff mass $\Lambda = 1/a$, the theory effectively behaves like a continuum theory with particle interactions, which may be appreciable. By a combination of known analytical methods, we here determine the maximal value of the renormalized coupling at zero momentum as a function of Λ/m, where m denotes the mass of the scalar particle in the theory. Moreover, a complete solution of the model is obtained in the sense that all low energy amplitudes can be computed with reasonable estimated accuracy for arbitrarily chosen bare coupling and mass in the symmetric phase region.

23494 (EFI—938(89)-86) Lagrangian of the self-duality equation and d=10, N=2b supergravity. Kavalov, A.R.; Mkrtchyan, R.L. (Erevanskij Fizicheskij Inst. (USSR)). 1986. 18p. NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701554/JAW.

An invariant (supersymmetric, Lorentz-invariant) Lagrangian of a ten-dimensional chiral extended supergravity is constructed up to bilinear over the Fermi fields terms inclusively. A new element is the introduction of a Lagrangian multiplier Θ/sub a1-a5b1-b5/, the var iation over which yields an equation equivalent to that of the self-duality of the supercovariant strength tensor of the physic al field A/sub μνλrho/. The field Θ/sub a1-a5b1-b5/ is a gauge field of a gauge symmetry, nontrivially acting only off the mass shell, which closes the formerly open s upersymmetry algebra on all the boson fields. 10 refs.

23495 (GSI—87-85(prepr.)) Nonlinear extensions of the Dirac equation and their implications in Q.E.D. . Ionescu, D.C.; Reinhardt, J.; Mueller, B.; Greiner, W.; Soff, G. (Frankfurt Univ. (Germany, F.R.). Inst. fuer Theoretische Physik). (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Frankfurt Univ. (Germany, F.R.). Inst. fuer Theoretische Physik). Dec 1987. 23p. NTIS (US Sales Only), PC A03/MF A01. Order Number TI88752471/JAW.

We investigate the influence of additional nonlinear terms in the Dirac Lagrangian on strongly bound electron states in heavy and superheavy atoms. Upper bounds for the coupling constants are deduced by comparison with precision spectroscopy data in Q.E.D. We demonstrate that nonlinear interactions may cause significant modifications of electron binding energies in superheavy quasiatomic systems which would not be visible in ordinary atomic physics measurements.

23496 (IFUSP-P—660) BRST structure of two dimensional conformal field theories. Rivelles, V.O. (Sao Paulo Univ. (Brazil). Inst. de Fisica). Sep 1987. 13p. NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701585/JAW.

We present a procedure to obtain the BRST charge for the representations of the Virassoro algebra. For $C \leqq 1$ the BRST charge has in general terms containing products of more than three ghosts. It is nilpotent for any allowed value of the central charge and conformal weight of the representation.

23497 (INIS-BR—917, pp 2) Analytic stochastic regularization in QCD and its supersymmetric extension. Abdalla, E.; Viana, R.L. (Sao Paulo Univ., Brazil. Inst. de Fisica). 1987. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701458/JAW. (CONF-8709236—).

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23532 (INIS-mf—10567, pp 109-118) **Bound states of heavy and light quarks and quantum chromodynamics.** Gavin, E.J.O.; Viollier, R.D. (Univ. of Cape Town, South Africa). 1986. NTIS (US Sales Only), PC A12/MF A01. Order Number DE87701986/JAW. (CONF-8607120—; CONF-8507150—).

From 21. annual seminar on theoretical physics; Johannesburg, South Africa (8 Jul 1986).

The papers on the 20th and 21st annual seminars on theoretical physics are bound in one volume.

The spectra of mesons consisting of a heavy quark (Q = c,b,t) and a light antiquark ($q^- = u^-,d^-,s^-$) are calculated in the framework of the M.I.T. bag model using for the Qq^- interaction a static potential related to the Fourier transform of the dressed gluon propagator. The hyperfine interaction due to the colourmagnetic interaction of the quarks is calculated in perturbation theory.

The resulting spectra are compared with the experimental data on the D ident to (cu^-, cd^-), D/sub s/ ident to (cs^-) and B ident to (bu^-, bd^-) mesons.

23533 **(ITEF—179(1986)) String and soliton construction of basic representation of Kac-Mudi.** Lebedev, D.R. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1986. 35p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number TI88701643/JAW.

String and soliton Kac - Frenkel - Sigal constructions are given on the example of Lee algebra Sl(N, C)-algebra of complex matrices with a zero trace. Kac - Frenkel - Sigal construction results in representation which is equivalent to the basis. Vertex operators being "generating functions" of this representation are naturally described in the theory of a boson string and two-dimensional conformal field theory. That is why Kac - Frenkel - Signal construction is called "String" construction of the basis representation. 11 refs.; 2 figs.

23534 **(ITEP—109(1987)) On the Hilbert space of supersymmetric quantum systems.** Shifman, M.A.; Smilga, A.V.; Vajnshtein, A.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 20p. NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701648/JAW.

It is shown that in some quantum-mechanical models the consequences of supersymmetry take place only provided certain additional conditions are imposed on the wave functions. If this fact is not taken into account one may encounter paradoxes. The question of the fermion condensate in the (reduced) σ model and supersymmetric gauge theories are discussed, in particular. 13 refs.

23535 **(JINR-R—2-86-545) Superstrings.** Filippov, A.T. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1986. 21p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87702982/JAW.

A short review is given of attempts to unify all known elementary interactions and superstring-based approaches to their solving are briefly described. General ideas, achievements and problems of the superstring theory, with a list of relevant references are presented. The role of Faddeev-Popov ghosts and of BRST-symmetries is discussed in some detail.

23536 **(JINR-R—2-87-376) Integrability of fermionic string in superfluid Hamiltonian approach.** Borodulin, V.I.; Isaev, A.P. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij; Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 14p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701662/JAW.

Submitted to the journal Zeit. Phys., C.

The Hamiltonian superfield formalism of fermionic string (FS) theory is introduced and is used for finding a general solution to the Hamiltonian equations of motion. An auxiliary spectral problem for FS-theory is investigated and an infinite set of conservation laws is constructed. Also, a method of constructing classical analogues of vertex operators describing the FS-massless field coupling is presented. 24 refs.

23537 **(RRK—86-7) One-loop induced topological term in QED_3.** Nagahama, Y. (Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics). Feb 1986. 22p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703020/JAW.

We consider the 2 + 1 dimensional massive QED and discuss the induced topological term in the one-loop level by using the higher derivative regularization. We show that the higher derivative regularization, which manifestly preserves the parity invariance when the fermion mass vanishes, automatically leads to a nonvanishing topological term in low energies. Although this higher derivative regularization formally violates the local gauge invariance, we propose a systematic way to recover the gauge invariance by adding local counter terms dictated by Ward-Takahashi identities. In practical applications, this regularization is interesting in connection with the discussion of the dynamaical origin of the quantum Hall effect.

23538 **(RRK—86-8) Gauge invariant actions of free closed superstring field theories.** Terao, H.; Uehara, S. (Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics). Feb 1986. 11p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703021/JAW.

We present a gauge invariant action of free N = 1 closed superstring field theory using BRS charges. This action is shown to take a similar form to that of open superstring. We also discuss about N = 2 closed superstring.

23539 **(RRK—86-19) Fermion emission vertex and space-time supersymmetry in superstring.** Terao, H.; Uehara, S. (Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics). May 1986. 26p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE87703023/JAW.

We construct an operator which converts the BRS charge in the Neveu-Schwarz sector to the one in the Ramond sector based on the fermion emission vertex. We also give space-time supersymmetry transformation laws in the covariant superstring field theory and discuss the relation between supercharge and the vertex.

23540 **(RRK—86-20) Comment on the one-loop finiteness in type-I superstring theory.** Yamamoto, H.; Nagahama, Y.; Nakazawa, N. (Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics). May 1986. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703024/JAW.

By using the Pauli-Villars method, one-loop divergence of the 4-point amplitude in SO(N) type-I superstring theory is studied. If one assigns the equal mass to the Pauli-Villars regulators appearing in the planar and nonorientable diagrams, the one-loop finiteness does not hold for N = 32. From the present view point, the principal-part prescription by Green and Schwarz corresponds to the different regulator mass assignment for the planar and nonorientable diagrams.

23541 **(RRK—86-21) Pathology of minimal subtraction renormalization in the analytically regularized 1/N expansion.** Suzuki, T.; Yamamoto, H. (Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics). May 1986. 32p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE87703025/JAW.

We show that a recently observed essential singularity in dimensionally regularized 1/N expansion appears generally in models having linear or quadratic divergences in the next to leading order of 1/N expansion without the direct relation to the asymptotic freedom of the models. Also analytic regularization produces the same kind of the one as in dimensional regularization when used in the 1/N expansion of O(N) (phi vector^2)/sub d=4/^{2} but not in the O(N) non-linear σ model in two dimensions. This singularity is accompanied by the term depending on the renormalization mass scale which makes the minimal subtraction method unable to be carried out. Typical examples are the three dimensional O(N) model with both bosons and fermions and (Yukawa)/sub d=4/ in addition to O(N) (phi vector^2)/sub d=4/^{2}.

23542 **(RRK—86-24) Transformation of variables and integration measures in path integrals.** Kubo, Reijiro. (Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics). Jun 1986. 14p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703028/JAW.

A specific transformation of variables in path integrals is studied in contrast with the so-called Nicolai mapping in the supersymmetry theory. Full bosonic and fermionic actions are reduced to free actions by this transformation. We derive some formulas, which are useful in evaluating path integrals.

23543 **(RRK—86-25) Comment on supersymmetrization of N = 1 D = 10 supergravity with Lorentz Chern-Simons term.** Sakai, Kenji. (Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics). Jun 1986. 13p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703029/JAW.

We re-examine supersymmetrization of the N = 1 D = 10 supergravity with Lorentz Chern-Simons term. The supersymmetric counterparts are determined to the first order of some Noether expansion parameter, and they have one arbitrary parameter.

23544 **(RRK—86-26) Simple evaluation of chiral anomalies in the path integral approach.** Fujikawa, K.; Ojima, S.; Yajima, S. (Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics). Jun 1986. 18p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703030/JAW.

We comment on the relation between the Schwinger's proper time method and the one-dimensional supersymmetric path integral method in the evaluation of chiral anomalies in gauge and gravitational interactions. For this purpose, we introduce a modified one-dimensional path integral which is directly related to the proper time method by a Legendre transformation. This modified scheme provides a simple way of evaluating chiral anomalies. The one-dimensional path integral method is also shown to work for the trace anomaly in 4-dimensional flat space-time.

23545 **(RRK—86-31) Field theoretical construction of an infinite set of quantum commuting operators related with soliton equations.** Sasaki, R.; Yamanaka, I. (Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics). Aug 1986. 26p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE87703031/JAW.

The quantum version of an infinite set of polynomial conserved quantities of a class of soliton equations is discussed from the point of view of naive continuum field theory. By using techniques of two dimensional field theories, we show that an infinite set of quantum commuting operators can be constructed explicitly from the knowledge of its classical counterparts. The quantum operators are so constructed as to coincide with the classical ones in the Planck constant -> 0 limit (Planck constant; Planck's constant divided by 2π). It is expected that the explicit forms of these operators would shed some light on the structure of the infinite dimensional Lie algebras which underlie certain class of quantum integrable systems.

23546 **(RRK—86-32) Recent developments in the path integral approach to anomalies.** Fujikawa, K. (Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics). Aug 1986. 24p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703032/JAW.

After a brief summary of the path integral approach to anomalous identities, some of the recent developments in this approach are discussed. The topics discussed include (i) Construction of the effective action by means of the covariant current, (ii) Gauss law constraint in anomalous gauge theories, (iii) Path integral approach to anomalies in superconformal transformations, (iv) Conformal and ghost number anomalies in string theory in analogy with the instanton calculation, (v) Covariant local Lorentz anomaly and its connection with the mathematical construction of the consistent anomaly.

23547 **(RRK—86-33) Ten dimensional N = 1 supergravity coupled to supersymmetric Yang-Mills fields in superspace.** Takao, Masaru. (Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics). Aug 1986. 35p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE87703033/JAW.

We present a superspace approach to the ten dimensional supergravity theory coupled to supersymmetric Yang-Mills fields proposed by Chapline and Manton. By postulating maximal constraint equations on the system, we derive an on-shell supergravity as a consequence of the forced closure of the Bianchi identities.

23548 **(RRK—86-38) Introduction to covariant formulation of superstring (field) theory.** Uehara, S. (Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics). Sep 1986. 16p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703038/JAW.

The present paper briefly discusses about covariant formulation of superstring theories based on BRS invariance. First, the Neveu-Schwarz-Ramond (NSR) model is outlined. This model describes a string on which fermions are living. Those fermions are described by two dimensional Majorana spinors, since a string spans a two dimensional surface, i.e., world sheet in the D-dimensional space-time. Discussions are then made on the relations between space-time bosons and fermions, super Virasoro algebra, no-ghost theorem, BRS charge, and supersymmetry in the NSR model Another section is devoted to describing covariant (free) field theory of superstring using the first-quantized BRS charges. Discussions are made on field theories of point particle, bosonic string and superstring, as well as space-time supersymmetry. It is concluded that field theories of closed strings including the heterotic string can be considered in similar ways. Interaction terms are constructed according to the BRS invariance of the total actions. Two kinds of them have been proposed, though the relation between them has not been clarified. Furthermore, covariant gauge fixing of interacting string field theories and/or covariant quantization have some difficulties and have not been clarified. It is also pointed out that the space-time supersymmetry would come from the 2-dimensional gauge symmetries, or could be ragarded as a part of the original string gauge symmetries.

23549 **(RRK—86-39) Pauli-Villars regularization and one-loop finiteness of type-I superstring theory.** Nakazawa, N.; Yamamoto, H. (Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics). Sep 1986. 25p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703039/JAW.

In a previous paper we reanalyzed the issue of one-loop finiteness of the light-cone 4-point amplitude of the type-I SO(N) superstring theory in terms of the Pauli-Villars regularization. The same analysis is applied, in this paper, to the 5-point amplitude in the light-cone formalism as well as to the parity-conserving covariant M-point amplitude and the generality of the previous results is confirmed. Namely, the assignment of the regulator masses to the planar and nonorientable diagrams is essentially arbitrary in the present scheme. However, once a particular mass assignment is fixed, by one way or another, it is firmly established that the one-loop finiteness condition picks up the same N for an arbitrary number M of external lines. In particular, the assignment 2 m/sub P/ = m/sub N/ renders all the one-loop amplitude finite for N = 32.

23550 **(RRK—86-40) Remarks on the time transformation of path-integral measures.** Kubo, R. (Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics). Sep 1986. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703040/JAW.

By means of a time transformation of path-integral measures we rewrite the usual Feynman path integral as a path integral of determinants with the Wiener measure. We derive a formula, which is useful in evaluating path integrals.

23551 **String-driven inflation.** Turok, N. (NASA/Fermilab Astrophysics Center, Fermi National Accelerator Laboratory, Batavia, Illinois 60510). *Physical Review Letters;* 60: No. 7, 549-552(15 Feb 1988).

It is argued that, in fundamental string theories, as one traces the universe back in time a point is reached when the expansion rate is so fast that the rate of string creation due to quantum effects balances the dilution of the string density due to the expansion. One is therefore led into a phase of constant string density and an exponentially expanding universe. Fundamental strings therefore seem to lead naturally to inflation.

23552 **KNO scaling in the parton branching model.** Sarcevic, I. (Theoretical Div., Los Alamos National Lab., Los Alamos, NM 87545). *Modern Physics Letters A;* **2**: No. 7, 513-524(Jul 1987).

The authors obtain a parton branching distribution P/sub mn/ of m quarks and n gluons. They show that this distribution does not obey exact KNO scaling. In the case when quark evolution is neglected, the probability distribution becomes wider as energy increases, in agreement with experimental data. The authors find that moments fit the data remarkably well with an increasing initial number of gluons and decreasing initial number of quarks. In this model, they predict the upper bounds for the probability distribution and multiplicity moments. They also give theoretical predictions for the multiplicities and moments for Tevatron Collider energies, indicating the slow narrowing of the probability distribution in this energy range.

23553 **Supercomputations in QCD.** Toussaint, D. (Univ. of California, San Diego, La Jolla). pp 111-120 of Computing in high energy physics. Ash, W. (ed.). Amsterdam, The Netherlands; North-Holland Physics Publishing (1987).

From Computing high energy physics; Pacific Grove, CA, USA (2 Feb 1987).

The author summarizes results from large scale simulations of lattice QCD. He also discusses the types of computers used in these simulations, including various custom processors for lattice gauge theory. 29 references, 6 figures.

23554 **APE computer: an array processor optimized for Lattice Gauge Theory simulations.** Albanese, M.; Bacilieri, P.; Cabasino, S.; Cabibbo, N.; Costantini, F.; Fiorentini, G.; Flore, F.; Fonti, L.; Fucci, A.; Lombardo, M.P.; Galeotti, S. (Universita' di Pisa, Italy). pp 345-353 of Computing in high energy physics. Ash, W. (ed.). Amsterdam, The Netherlands; North-Holland Physics Publishing (1987).

From Computing high energy physics; Pacific Grove, CA, USA (2 Feb 1987).

The APE computer is a high performance processor designed to provide massive computational power for intrinsically parallel and homogeneous applications. APE is a linear array of processing elements and memory boards that execute in parallel in SIMD mode under the control of a CERN/SLAC 3081/E. Processing elements and memory boards are connected by a circular switchnet. The hardware and software architecture of APE, as well as its implementation are discussed in this paper. Some physics results obtained in the simulation of lattice gauge theories are also presented. 2 references, 5 figures.

65 PHYSICS II

REFER ALSO TO CITATION(S) 23230

6510 Nuclear Physics

REFER ALSO TO CITATION(S) 21589, 22230, 23681, 23683, 24041

23555 **(DOE/ER/40271—T1) Central collisions of heavy ion physics: Supplemental annual report, October 1, 1987-March 31, 1988.** Fung, S.Y. (California Univ., Riverside (USA). Dept. of Physics). Feb 1988. Contract FG03-86ER40271. 6p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88006266/JAW.

This report briefly describes the activities of the Heavy Ion Physics Group at the University of California, Riverside in the six months from October 1, 1987 to March 31, 1988. During this period, our program continues to focus on correlation studies in central collisions at the Bevalac and AGS energies, and neutrino interactions and oscillation studies at LAMPF.

23556 (INIS-BR—934, pp 51) **D(d,np)X,Y breakup reaction.** Cabral, S.C.; Borker, G.; Klein, H.; Manhart, W. (Instituto de Engenharia Nuclear, Rio de Janeiro, Brazil; Physikalisch-Technische Bundesanstalt, Braunschweig, Germany, F.R.). 1987. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701471/JAW. (CONF-8708216—).

From 10. workshop on nuclear physics in Brazil; Caxambu, MG, Brazil (26 Aug 1987).

23557 **(JAERI-M—86-150) GAMFIL: a computer program for generating photon production nuclear data file.** Hida, K. (Japan Atomic Energy Research Inst., Tokyo). Oct 1986. 38p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE87702954/JAW.

A computer program GAMFIL was developed in order to generate a photon production nuclear data file with the ENDF/B format. By assuming that evaluation is performed with the nuclear reaction theory code GNASH, GAMFIL converts the GNASH output into a data file in the ENDF/B format. For this purpose, output subroutines of GNASH were partly modified.

23558 (JINR—R-7-86-322, pp 39) **Study on the product characteristics from reactions giving rise to product compound systems with Z=108.** Zodan, Kh.; Luk'yanov, S.M.; Penionzhkevich, Yu.Eh. 1986. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780065/JAW.

In Heavy ion physics - 1985. Collection of annotations of the Nuclear Reaction Laboratory of the Joint Nuclear Research Institute works, 1985.

23559 (JINR—R-7-86-322, pp 40) **Investigation on the fast neutron emission in the heavy ion reactions.** Blinov, M.V.; Kovalenko, S.S.; Kozulin, Eh.M. (Radievyj Inst., Leningrad, USSR). 1986. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780065/JAW.

In Heavy ion physics - 1985. Collection of annotations of the Nuclear Reaction Laboratory of the Joint Nuclear Research Institute works, 1985.

23560 (JINR—R-7-86-322, pp 41) **Giant resonance excitation in the reactions with /sup 22/Ne and /sup 40/Ar heavy ions.** Kamanin, V.V.; Kugler, A.; Mikhajlova, T.I. 1986. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780065/JAW.

In Heavy ion physics - 1985. Collection of annotations of the Nuclear Reaction Laboratory of the Joint Nuclear Research Institute works, 1985.

23561 **(JINR-R—6-87-201) Determination of the physicl constants of the ground state and quadrupole vibrational states and energy-level transitions in even-even deformed nuclei. Magnetic M1-transitions.** Adam, I.; Vagner, V.; Gonusek, M.; Krivopustov, M.I.; Morozov, V.A. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderne Fyziky; Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1987. 11p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701667/JAW.

The determination of physical constant of nuclear structure of ground, quadrupole vibrational states and gamma-transitions in even-even deformed nuclei are considered. Obtained formulae for determination of reduced probabilities of magnetic M1-interband and intraband transitions are obtained. Reduced probabilities B(M1) were calculated using perturbation theory and assumed mixing wave functions. 21 refs.; 1 tab.

23562 **(PINSTECH/NED—123) Conservation of nuclear track parameters to particle parameters in heavy ion interaction studies using track detectors.** Jamil, A.K.; Saadi, M.Z.; Khan, H.A. (Pakistan Inst. of Nuclear Science and Technology, Rawalpindi. Nuclear Engineering Div.). Jul 1984. 13p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701219/JAW.

Analytical expressions for elastic and inelastic binary reactions have been derived in terms of known track parameters. A computer programme, PROBE (PROGRAMME FOR BINARY EVENTS) has been developed using FORTRAN IV programming languge to convert the track parameters into (a) Particle Parameters (mass, energy, momentum, etc.) and Q-value of the reaction. The programme has been tested for the binary data of "1050 MeV /sup 84/Kr+U (natural)" reaction in mica Solid State Nuclear Detectors. (author). 10 refs, 5 figs.

23563 (JINR—D-3,4,17-86-747, pp 29-46) **Neutron resonance averaging.** Chrien, R.E. (Brookhaven National Lab., Upton, NY, USA). 1987. NTIS (US Sales Only), PC A21/MF A01. Order Number DE88780064/JAW. (CONF-8610176—).

From 5. international school on neutron physics; Alushta, USSR (20 Oct 1986).

The principles of resonance averaging as applied to neutron capture reactions are described. Several illustrations of resonance averaging to problems of nuclear structure and the distribution of radiative strength in nuclei are provided. The technique of resonance averaging has been shown to be a useful tool for (n, γ) research, particularly when care is applied to the analysis to quantify the effect of the Purter Thomas fluctuations of the contributing resonances. The method is able to locate ad place a complete set of states in a certain spinparity range. It can reliably assign average transition strengths, separated according to multipolarity, and is an excellent way to determine radiative strength functions. 30 refs.; 12 figs.

23564 (JINR—D-3,4,17-86-747, pp 47-60) **Neutron spectroscopy with GELINA.** Weigmann, H. (Commission of the European Communities, Brussels, Belgium. Committee on Energy, Research and Technology). 1987. NTIS (US Sales Only), PC A21/MF A01. Order Number DE88780064/JAW. (CONF-8610176—).

From 5. international school on neutron physics; Alushta, USSR (20 Oct 1986).

A brief description of the Geel linear accelerator (GELINA) and its main characteristics are presented. Representative examplex for two types of measurements are discussed. High resolution neutron resonance spectroscopy aims at the investigation of nuclear structure at excitation energies above neutron emission threshold. In nuclei with not too high a level density, states at these energies are still expected to be sufficiently simple for an interpretation in terms of nuclear models, and the distribution of neutron and radiative strengths is expected to serve as a signature for their structure. The study of neutron induced fission helps to investigate the structure of the fission barrier and the properties of nuclear states at very large deformation. 26 refs.; 14 figs.

6511 Experimental Techniques

REFER ALSO TO CITATION(S) 22363, 22487, 22488

23565 **Nuclear structure studies using beams of radioactive nuclei.** Tanihata, I. (RIKEN, 21, Hirosawa, Wako, Saitama 351-JAPAN). *AIP (American Institute of Physics) Conference Proceedings;* **164**: No. 1, 213-222(10 Dec 1987). (CONF-870970—).

From 5. international conference on nuclei far from stability; Lake Rosseau, Canada (14 Sep 1987).

A review of recent studies of the nuclear structure of unstable nuclei produced from nuclear fragmentation reactions. Measurements of nuclear radii and nuclear magnetic moments have been made using these types of reactions. (AIP)

6512 Nuclear Properties And Reactions, A=1-5, Experimental

23566 **(CEA-CONF—9101) Electron scattering and nuclear shapes.** Goutte, D. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Nucleaire a Haute Energie). Jul 1987. 19p. (CEA-DPH-N-S—2468B; CONF-8706193—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88752148/JAW.

From International conference on nuclear shapes; Crete, Greece (28 Jun 1987).

This contribution shows that the electron scattering experiments provide detailed information on the radial behavior of the nuclear wave functions through the precise measurement of the charge and transition charge densities.

23567 **(JINR—R-1-87-93) Momentum distribution of protons and deuterons from /sup 3/He fragmentation at 10.78 GeV/c on carbon at zero angles.** Ableev, V.G.; Anchishkin, D.V.; Dimitrov, Kh. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1987. 4p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701155/JAW.

Submitted to the journal JETP Lett. .

Differential cross sections of the (/sup 3/He, d), (/sup 3/He, p) reactions with fragment forward emission have been measured for the first time in wide region of their momenta. It is shown that these spectra represented as functions of relativistic internal momentum are identical. The (/sup 3/He, d) reaction spectrum was compared with the calculations making allowance for the /sup 3/He wave functions. 12 refs.; 2 figs.

23568 (JINR—R-7-86-322, pp 34) **Search for the /sup 4/H, /sup 5/H, /sup 6/H nuclei at /sup 9/Be target irradiation by accelerated /sup 11/B ions.** Belozerov, A.V.; Borcha, K.; Dlougy, Z.; Kalinin, A.M.; Kalpakchieva, R.; Nguen Khoaj T'yau; Oganesyan, Yu.Ts.; Penionzhkevich, Yu.Eh. 1986. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780065/JAW.

In Heavy ion physics - 1985. Collection of annotations of the Nuclear Reaction Laboratory of the Joint Nuclear Research Institute works, 1985.

23569 **(KFK—4322) Measurement of the cross section and the vector analyzing power of the π/sup +/d -> π/sup +/pn reaction in a kinematical complete experiment.** List, W. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Kernphysik; Karlsruhe Univ. (T.H.) (Germany, F.R.). Fakultaet fuer Physik). Nov 1987. 98p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number TI88752485/JAW.

The triple differential cross section and the vector analyzing power iT/sub 11/ was measured for the deuteron break-up reaction πd -> πpn. Cross section data were taken for 9 pion-proton-angle pairs at T/sub π/ = 294 MeV, iT/sub 11/ data for 36 angle pairs at T/sub π/ = 134 MeV and T/sub π/ = 228 MeV. The scattering events were determined kinematically complete by measuring the scattering angles of the pion and the proton and the momentum of the proton. The data were compared with a relativistic 3-body-calculation by H. Garcilazo. There is a good agreement between theory and data over the whole phase space, both for the cross section and iT/sub 11/. Furthermore calculations were done with taking only special parts of the πN- or NN-interaction into account. The results of these studies are then following: The cross section in the NN final state interaction region is predicted correctly only by the full calculation, the impulse approximation is too low by an order of magnitude. The cross section in this region is dominated by the T=0 (J=1) part of the NN-interaction ($\geqq$ 80%). The small πN partial waves are necessary to describe the vector analyzing power correctly.

23570 (KFKI—1987-47/A) Study of proton-deuteron break-up reaction in exclusive experiment at 1 GeV. Aleshin, N.P.; Belostotskij, S.L.; Dotsenko, Yu.V. and others. (AN SSSR, Leningrad. Inst. Yadernoj Fiziki). (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). Jul 1987. 12p. NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701762/JAW.

The exclusive proton-deuteron break-up reaction pD yields ppn was studied at 1 GeV. Differential cross sections and polarizations of the final protons were measured in the range of neutron-spectator momenta 0<k/sub 3/<0.3 GeV/c and 0<k/sub 3/<0.2 GeV/c, respectively. The data obtained are well described within the framework of impulse approximation with the Paris wave function of the deuteron.

23571 Study of the reaction H(d vector, 2p)n at 16 MeV around collinear configurations. Correll, F.D.; Brown, R.E.; Ohlsen, G.G.; Hardekopf, R.A.; Jarmie, N.; Lambert, J.M.; Treado, P.A.; Slaus, I.; Schwandt, P.; Doleschall, P. (Naval Academy, Annapolis, MD (USA). Dept. of Physics; Los Alamos National Lab., NM (USA); Georgetown Univ., Washington, DC (USA); Institut Rudjer Boskovic, Zagreb (Yugoslavia); Indiana Univ., Bloomington (USA)). *Nuclear Physics [Section] A;* **475**: No. 3, 407-421(21 Dec 1987).

The cross section and the analyzing powers A/sub y/, A/sub xx/, A/sub xz/ and A/sub yy/ for the reaction H(d vector, 2p)n are studied by kinematically overdetermined measurements at an incident energy of 16 MeV at collinear and somewhat off-collinear kinematic conditions. A three-body Faddeev model using two realistic separable potentials that have different short-range parts gives a good fit to the data. Uncertainties in Coulomb corrections make it difficult to draw definitive conclusions about possible three-nucleon force effects at collinearity conditions.

6513 Nuclear Properties And Reactions, A=6-19, Experimental

23572 (CRN/PN—87-17) Resonances in the nuclear reactions /sup 15/N + /sup 12/C and /sup 15/N + /sup 16/O. Monnehan, G.A. (Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires; Strasbourg-1 Univ., 67 (France)). Jun 1987. 133p. (In French). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88752137/JAW.

The reaction /sup 12/C + /sup 15/N have been studied at /sup 15/N beam energies between 30 and 70 MeV. For each reaction, about twelve residual nuclei have been identified through the γ-ray detection method. Excitation functions were obtained for the fusion and peripheral channels. Resonances are seen in the channels containing at least one α particle at energies below 50 MeV. At higher energies, strong structures are observed in the direct reaction channels. The evolution of the fusion cross section is well reproduced by a model based on the statistical desexcitation of the compound nucleus if the discrete states of the residual nuclei are taken into account. The favourable observation of resonant phenomena in /sup 15/N induced reactions can be understood in terms of a small number of channels open to the grazing wave. In the range 50 to 60 MeV, there is a strong coupling between the fusion and the direct reaction channels. The occurrence of resonances above E/sub lab/ = 50 MeV in the peripheral channels is explained with the band crossing and effective barrier models. In the /sup 15/N induced reactions, the absorption of the surface waves is weak.

23573 (GANIL-P—87-21) Mass-measurements far from stability of neutron rich light nuclei. Mittig, W.; Gregoire, C.; Schutz, Y. (Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France)). Jul 1987. 12p. (CONF-8706234—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88752119/JAW.

From International school of physics Enrico Fermi: course on trends in nuclear physics; Varenna, Italy (23 Jun 1987).

The study of nuclei far from stability is a verification of nuclear models that generally have been established using the properties of stable nuclei. The direct measurement of the mass has considerable advantages for nuclei very far from stability. This implies a high resolution measurement device, reasonable production rates of the nuclei of interest, and very low systematic errors. This is discussed here. Some of the results have been published recently. They are compared to different classes of models. Region presented is Z=9-15 region.

23574 (INIS-BR—934, pp 11) Study of limitation of the fusion cross section for /sup 19/F + /sup 19/F and /sup 10/,/sup 11/B+/sup 27/Al systems. Anjos, R.M. dos; Guimaraes, V.; Toledo, A.S. de; Szanto, E.M.; Carlin Filho, N.; Coimbra, M.M.; Added, N.; Figueira, M.C.S.; Fante Junior, L.; Asche, R. (Sao Paulo Univ., Brazil. Inst. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701471/JAW. (CONF-8708216—).

From 10. workshop on nuclear physics in Brazil; Caxambu, MG, Brazil (26 Aug 1987).

23575 (INIS-BR—950) Study of the /sup 10/, /sup 11/B(p,n)/sup 10/, /sup 11/C reactions between Ep=13,7 and 14,7 MeV. Schelin, H.R. (Sao Paulo Univ. (Brazil). Inst. de Fisica). 1985. 164p. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. Order Number TI88701604/JAW.

Using time-of-flight facilities of the Sao Paulo 8UD Pelletron Accelerator, absolute differential cross sections for the n/sub 0/, n/sub 1/, n/sub 2/, n/sub 3/, (n/sub 4/+n/sub 5/), n/sub 6/ and n/sub 7/ groups for the reaction /sup 11/B(p,n)/sup 11/C and the n/sub 0/ and n/sub 1/ neutron groups for the reaction /sup 10/B(p,n)/sup 10/C have been measured at incident proton energies of 14.0, 14.3 and 14.6 MeV in the angular interval of 20 to 160 degrees. Excitation functions at θ/sub lab/=20 deg from Ep=13.7 to 14.7 MeV in intervals of 100 KeV were also measured. The theoretical analysis was conducted to determine relative contributions of the diret and compound nucleus processes in the differential cross sections. To this end, a two couple channel model model for the reactions was assumed. The DWBA model for the direct and the Hauser-Feshbch for the compound nucleus processes were in such a way as to simulate the exact coupled channels calculation through an appropriate choice of the absorption term W in the optical potential. The results indicate that about half of the cross section is due to the compound nucleus mechanism. The theoretical analysis aimed at obtaining the elastic enhancement factor for the channel /sup 11/B(p,n/sub 0/) /sup 11/C at Ep=14.3 MeV. This has been demonstrated to appear in compound nucleus charge reactions by Harney, Weidemueller and Richter and predicted to attain the value 2 when isospin is conserved. Our results show an enhancement factor larger than 1 indicating that isospin mixing is weak in this reaction.

23576 (JINR—R-7-86-322, pp 35) Experiments on determination of the /sup 9/He nucleus mass defect in the /sup 9/Be + /sup 14/C reaction. Belozerov, A.V.; Borcha, K.; Dlougy, Z. 1986. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780065/JAW.

In Heavy ion physics - 1985. Collection of annotations of the Nuclear Reaction Laboratory of the Joint Nuclear Research Institute works, 1985.

23577 (JINR-R—1-86-141) Investigation of a possibility of cumulative hadron production as a result of isobar state decay. Kopylova, D.K.; Lyubimov, V.B.; Nikitina, V.F.; Togoo, R.; Sherkulov, U.D. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1986. 5p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87702973/JAW.

The spectra of effective masses of hadron pairs including cumulative pions and protons have been analysed in cumulative pC-interactions found in the images from the 2-meter propane bubble chamber irradiated by protons with P/sub P/=10GeV/c. The conclusion has been drawn that the production of cumulative pions and protons is not connected with Δ-isobar or dibaryon resonance decay. 6 references, 7 figures.

23578 (JINR-R—1-86-312) Stopping and thermalization of a matter in nucleus-nucleus collisions and quark-gluon plasma production problems. Okonov, Eh.O. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1986. 11p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87702974/JAW.

Analysis was performed in order to examine and to compare the Berkeley and Dubna indications of nuclear matter stopping and thermalization in central nucleus-nucleus collisions. The thermalization obtained in a synchrophasotron nuclear beam (A — 12-20) at much higher energy than that of Bevalac (3.6 A GeV as compared with 0.8 A GeV) can be understood to be due to the Dubna experimental approach in which essentially central collisions with Λ and K-production, i.e. rare events with high local excitation (fluctuations) at a cross section level of $\sigma \leqq 10^{-3}$ σ/sub in/ have been detected. The Boltzmann temperature of the Λ produced was observed to become as high as 150 MeV (from — 80 MeV) with increasing nuclear collision centrality. In the events with even more higher excitation (if cumulative Λ/sup k/-particle with $p^* \geqq 1$ GeV/c was produced)π^--mesons seem to be thermalized as well. This would be due to the fact that the main part of interacting nuclei were involved in the thermallization process in such events. An increase of Λ/sup k/-particles relative yield and of their density in the midrapidity region observed under these conditions were examined as a predicted signatures of quark-gluon plasma formation. Experimental problems of a further study of such signatures are discussed. 35 references, 4 figures, 1 table.

23579 (LBL—24399) Super high energy heavy ion collisions. Geist, W.M. (Lawrence Berkeley Lab., CA (USA)). Dec 1987. Contract AC03-76SF00098. 19p. (CONF-8708174—5). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006346/JAW.

From 7. international conference on physics in collision; Tsukuba, Japan (25 Aug 1987).

Basic theoretical ideas on a phase transition to a plasma of free quarks and gluons in heavy ion collisions are outlined. First results from experiments with oxygen beams at 14.5 GeV/c/N (BNL), 60 and 200 GeV/c/N (CERN) are discussed. 30 refs., 9 figs.

23580 Direct mass measurements of light neutron-rich nuclei using fast recoil spectrometers. Vieira, D.J.; Wouters, J.M.; TOFI Collaboration. (Los Alamos National Laboratory, Los Alamos, NM 87545). *AIP (American Institute of Physics) Conference Proceedings;* **164**: No. 1, 1-10(10 Dec 1987). (CONF-870970—).

From 5. international conference on nuclei far from stability; Lake Rosseau, Canada (14 Sep 1987).

Extensive new mass measurement capabilities have evolved with the development of recoil spectrometers. In the Z = 3—9 neutron-rich region alone, 12 direct mass measurements have been determined for the first time by the fast—recoil direct mass measurement method. A recent experiment using the TOFI spectrometer illustrates this technique. A systematic investigation of nuclei that lie along or near the neutron-drip line has provided a valuable first glimpse into the nuclear structure of such nuclei. No evidence for a large single-particle energy gap at N = 14 is observed; however, a change in the two-neutron separation energy trend is found at N = 15. This change is correctly predicted by shell model calculations, and is interpreted in terms of the smaller 1s/sub 1/2/—1s/sub 1/2/ interaction compared to that of the Od/sub 5/2/—Od/sub 5/2/ neutron—neutron interaction.

6514 Nuclear Properties And Reactions, A=20-38, Experimental

23581 (JINR-R—2-87-37) On the gathering model in cumulative meson production. Reznik, B.L.; Titov, A.I. (Dal'nevostochnyj Gosudarstvennyj Univ., Vladivostok (USSR); Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701660/JAW.

Calculation is made of the invariant cross sections of production of cumulative mesons in the "gathering" model. It is shown that this model gives theoretical values for the cross sections of pion production exceeding the experimental ones by an order of magnitude. For the case of cumulative kaons, the model result is by factor of two to ten lower than the experimental result, depending on the kaon sign and atomic weight of a target-nucleus. To get qualitative agreement with experiment, it is necessary to assume that the probability of formation, in a nucleus, of compound systems which are a source of the cumulative mesons in the gathering model is highly dependent on the type of cumulative meson, which contradicts the fundamental principle of causality. 18 refs.; 6 figs.; 1 tab.

23582 (LBL—24520) Subthreshold pion production. Miller, J. (Lawrence Berkeley Lab., CA (USA)). Nov 1987. Contract AC03-76SF00098. 9p. (CONF-8711116—4). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005759/JAW.

From 8. high energy heavy ion study; Berkeley, CA, USA (16 Nov 1987).

This process is relatively well-understood, and one of the aims of subthresold production experiments is to identify other collective effects. Some possible signatures of collective effects are: Production below the 'absolute' threshold; production in excess predictions of nucleon-nucleon models; and a change in the characteristic behavior of the pion spectra as the threshold is crossed. This paper discusses these collective effects especially the last one. (LSP)

6515 Nuclear Properties And Reactions, A=39-58, Experimental

23583 (CONF-8711116—3) Fission induced by peripheral reactions with ^{56}Fe + ^{197}Au at 100 MeV/u. Videbaek, F.; Dichter, B.; Kaufman, S.; Hansen, O.; Levine, M.J.; Thorn, C.E.; Trautman, W.; Boissevain, J.; Blaich, T.; Fowler, M. (Argonne National Lab., IL (USA); Brookhaven National Lab., Upton, NY (USA); Los Alamos National Lab., NM (USA); Lawrence Livermore National Lab., CA (USA); Oak Ridge National Lab., TN (USA); Michigan State Univ., East Lansing (USA)). 1987. Contract W-31109-ENG-38;AC02-76CH00016;AC05-84OR21400. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005996/JAW.

From 8. high energy heavy ion study; Berkeley, CA, USA (16 Nov 1987).

Results of peripheral fission at 100 MeV/u ^{56}Fe + ^{197}Au have been presented. The average momentum transfer shows a limiting momentum transfer to the target residue system that subsequently decays to binary fission. An analysis in terms of INC calculations shows promise in being able to describe the data, and a detailed comparison will tell us more about the limits to conventional compound nucleus formation and statistical evaporation in heavy ion reactions at intermediate energies. The well known fission process again is used as a tool to understand more complicated reaction mechanisms. 11 refs., 8 figs.

23584 (INIS-BR—934, pp 17) Measurements of fusion cross sections of /sup 16/O+ /sup 46/,/sup 50/ Ti systems. Liguori Neto, R.; Acquadro, J.C.; Toledo, A.S. de; Carlin Filho, N.; Coimbra, M.M.; Crema, E.; Gomes, P.R.S. (Sao Paulo Univ., Brazil. Inst. de Fisica; Universidade Federal Fluminense, Niteroi, Brazil. Inst. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701471/JAW. (CONF-8708216—).

From 10. workshop on nuclear physics in Brazil; Caxambu, MG, Brazil (26 Aug 1987).

6516 Nuclear Properties And Reactions, A=59-89, Experimental

23585 **Beta-delayed proton decay in the lanthanide region.** Nitschke, J.M.; Wilmarth, P.A.; Gilat, J.; Moeller, P.; Toth, K.S. (Lawrence Berkeley Laboratory, University of California, Berkeley, CA 94720). *AIP (American Institute of Physics) Conference Proceedings;* **164**: No. 1, 697-707(10 Dec 1987). (CONF-870970—). Contract AC03-76SF00098;AC05-84OR21400.

From 5. international conference on nuclei far from stability; Lake Rosseau, Canada (14 Sep 1987).

A total of 24 new β-delayed proton precursors and several new decay branches in the region of 56<Z<72 and N<82 have been identified with the OASIS on-line mass separator facility at the SuperHILAC in Berkeley. Proton spectra and halflives were measured for all precursors. Additional properties determined for many of the isotopes include spins and parities of the precursors, final state feedings, proton branching ratios, (Q/sub E//sub C/—S/sub P/) energy differences, and new levels in the proton decay daughters. Mixed β-delayed proton decay from precursor isomers and ground states has been observed. The proton decay has been compared to statistical model calculations using Gamow-Teller (GT) β-strength functions obtained from RPA calculations with Nilsson model wave functions. For the N = 81 precursors /sup 151/Yb, /sup 149/Er, and /sup 147/Dy, pronounced structure in the proton spectra has been observed. An interpretation of this structure in the framework of "doorway" states is proposed.

6517 Nuclear Properties And Reactions, A=90-149, Experimental

23586 (INIS-BR—934, pp 82) **Rotational bands in /sup 136/Pr.** Emediato, L.G.R.; Cybulska, E.W.; Rao, M.N.; Seale, W.A.; Ribas, R.V.; Botelho, S.; Medina, N.H.; Oliveira, J.R.B. de; Almeida, M. de. 1987. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701471/JAW. (CONF-8708216—).

From 10. workshop on nuclear physics in Brazil; Caxambu, MG, Brazil (26 Aug 1987).

23587 (INIS-BR—934, pp 84) **Nuclear structure of /sup 132/La and /sup 130/La.** Oliveira, J.R.B. de; Almeida, M. de; Cybulska, E.W.; Rao, M.N.; Seale, W.A.; Ribas, R.V.; Botelho, S.; Medina, N.H.; Emediato, L.G.R. 1987. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701471/JAW. (CONF-8708216—).

From 10. workshop on nuclear physics in Brazil; Caxambu, MG, Brazil (26 Aug 1987).

23588 (INIS-BR—934, pp 89) **Gyromagnetic ratio of excited states of /sup 109/,/sup 107/Ag.** Medina, N.H.; Ribas, R.V.; Rao, M.N.; Seale, W.A.; Cybulska, E.W.; Emediato, L.G.R.; Brandao, J.R.; Botelho, S.; Almeida, M. 1987. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701471/JAW. (CONF-8708216—).

From 10. workshop on nuclear physics in Brazil; Caxambu, MG, Brazil (26 Aug 1987).

23589 (INIS-BR—934, pp 59) **Absolute measurement of /sup 137/Cs decay rate by 4PI(BS) e-bar - X coincidence.** Koskinas, M.F.; Dias, M.S. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, Brazil). 1987. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701471/JAW. (CONF-8708216—).

From 10. workshop on nuclear physics in Brazil; Caxambu, MG, Brazil (26 Aug 1987).

23590 **(JINR-E—1-86-642) Determination of matter densities in $^{131}Xe_{54}$ nucleus using negatively charged pions.** Strugalski, Z.; Miller, K.; Pluta, J.; Alrohiah, M.; Pawlak, T. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1986. 6p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87702969/JAW.

Method for nuclear matter density distribution determination using strongly interacting probes is proposed. As an example the matter distribution in xenon is determined. The matter distribution in the nucleus does not differ markedly from the charge distribution and does not extend by mach beyond it; the matter distribution seems to be constant but the number of the protons met by a hadron in traversing nucleus changes in definite manner, on average this number corresponds to the neutron-proton ratio (A-Z)/Z. 10 references, 1 figure.

23591 **Tristan research on neutron rich-nuclei: Magnetic moments and nuclear structure.** Wolf, A.; Casten, R.F.; Gill, R.L.; Brenner, D.S.; Mach, H.; Hill, J.C.; Wohn, F.K.; Winger, J.A. (Brookhaven National Laboratory, Upton, New York, 11973, USA). *AIP (American Institute of Physics) Conference Proceedings;* **164**: No. 1, 174-183(10 Dec 1987). (CONF-870970—). Contract AC02-76CH00016.

From 5. international conference on nuclei far from stability; Lake Rosseau, Canada (14 Sep 1987).

The TRISTAN research program is briefly outlined. The discussion then turns to the measurements of magnetic moments of excited states in neutron-rich fission product nuclei using the perturbed angular correlation method. The results for 2^+_1 states are analyzed in light of the systematics of magnetic moments in the A = 70—200 region, and in relation to collective nuclear models.

23592 **Spectroscopy of the transitional A = 96—98 nuclei; New region of fast first forbidden transitions.** Mach, H.; Gill, R.L.; Molnar, G.; Casten, R.F.; Wolf, A.; Winger, J.A. (Clark University, Worcester, Massachusetts, 01610). *AIP (American Institute of Physics) Conference Proceedings;* **164**: No. 1, 282-285(10 Dec 1987). (CONF-870970—).

From 5. international conference on nuclei far from stability; Lake Rosseau, Canada (14 Sep 1987).

Absolute γ-intensities have been measured for the strong transitions in the decay chain $^{98}Rb \rightarrow ^{98}Sr \rightarrow ^{98}Zr$ and $^{98}Nb \rightarrow ^{98}Mo$ and found $\simeq$4 times higher than those currently adopted. Shape coexistence is established in ^{99}Y with a J/sup π/ = 1^- "spherical" ground state and with a previously reported deformed band with band-head at 495.7 keV. A fast first-forbidden β-transition is observed between ^{99}Y/sup g/ and ^{99}Zr/sup g/, which alongside with the previously reported ^{96}Y/sup g/$\rightarrow ^{96}Zr$/sup g/ decay forms a new region, other than /sup 208/Pb and ^{16}O, of such fast transitions.

23593 **Evidence for shape coexistence in neutron-rich Rh and Ag isotopes.** Kaffrell, N.; Rogowski, J.; Tetzlaff, H.; Trautmann, N.; De Frenne, D.; Heyde, K.; Jacobs, E.; Skarnemark, G.; Alstad, J.; Harakeh, M.N.; and others. (Institut fuer Kernchemie, Universitaet Mainz, D-6500 Mainz, Germany). *AIP (American Institute of Physics) Conference Proceedings;* **164**: No. 1, 286-295(10 Dec 1987). (CONF-870970—).

From 5. international conference on nuclei far from stability; Lake Rosseau, Canada (14 Sep 1987).

Neutron-rich nuclei of Rh and Ag have been investigated by γ-ray single and $\gamma\gamma$(t)-coincidence measurements after the β^--decay of their precursors. The Ru and Pd activities for the decay studies were produced in the /sup 249/Cf(n/sub t//sub h/,f) reaction and separated from the fission product mixture using on-line chemical procedures. In addition, single-particle transfer reactions like (d,^{3}He) and (^{3}He,d) were performed as far as stable target material has been available.

23594 **Structure of the odd-odd and odd-mass Sb nuclides.** Stone, C.A.; Faller, S.H.; Robertson, J.D.; Walters, W.B. (University of Maryland, College Park, MD 20742 U.S.A.). *AIP (American Institute of Physics) Conference Proceedings;* **164**: No. 1, 429-440(10 Dec 1987). (CONF-870970—).

From 5. international conference on nuclei far from stability; Lake Rosseau, Canada (14 Sep 1987).

We have performed experiments on the β-decay of several Sn nuclides near /sup 132/Sn. The multiplet structure of /sup 132,130/Sb was studied and an extensive level scheme was constructed for the decay of the 7-isomer in /sup 130/Sn. These investigations were extended to /sup 131,129,127/Sb where the proper-

ties of the more complex multiplets were determined. Extensive high-spin level schemes were constructed for the decay of /sup 131,129/Sn and a 19/2-, β-decaying isomer was placed in the /sup 129/Sb level scheme. A partial level is presented for the decay of the 19/2- isomer into levels of /sup 129/Te.

23595 **Energy levels and structure of light rare-earth nuclei /sup 136,138,140/Sm and /sup 132,134,136/Nd, via beta decay.** Kern, B.D.; Leander, G.A.; Mlekodaj, R.L.; Carter, H.K.; Kortelahti, M.O.; Zganjar, E.F.; Braga, R.A.; Fink, R.W.; Perez, C.P.; Semmes, P.B.; and others. (University of Kentucky, Lexington, KY 40506). *AIP (American Institute of Physics) Conference Proceedings;* **164**: No. 1, 441-444(10 Dec 1987). (CONF-870970—).

From 5. international conference on nuclei far from stability; Lake Rosseau, Canada (14 Sep 1987).

Levels in /sup 136,138,140/Sm were populated by the beta decay of Eu, following (HI,pxn) reactions and on-line mass separation, Members of the γ band were observed in all three daughter nuclei. Spectroscopic calculations were made using the triaxial rotor model, with all parameters derived microscopically from Woods—Saxon deformed shell model. Comparison with the data supports the characterization of these nuclei in terms of a triaxial intrinsic shape. Improved decay schemes for /sup 132,134,136/Nd are given.

23596 **Level structure of neutron-rich odd-mass Pr nuclides.** Mantica P.F. Jr.; Baum, E.F.; Robertson, J.D.; Stone, C.A.; Walters, W.B.; Kusnezov, D.F.; Meyer, R.A. (University of Maryland, College Park, MD 20742). *AIP (American Institute of Physics) Conference Proceedings;* **164**: No. 1, 455-458(10 Dec 1987). (CONF-870970—).

From 5. international conference on nuclei far from stability; Lake Rosseau, Canada (14 Sep 1987).

Results of recent studies of the structures of odd mass neutron-rich Pr nuclides, /sup 143/Pr, /sup 145/Pr, and /sup 147/Pr populated in the decay of /sup 143/Ce, /sup 145/Ce, and /sup 147/Ce, respectively, will be described and discussed. PTQM calculations for the structure of these nuclides will be presented and compared with the experimentally observed levels.

23597 **Structure of /sup 143/Ba and /sup 147/Ce.** Robertson, J.D.; Walters, W.B.; Faller, S.H.; Stone, C.A.; Baum, E.M.; Mantica, P.F.; Gill, R.L.; Piotrowski, A. (Dept. of Chemistry, University of Maryland, College Park, MD 20742). *AIP (American Institute of Physics) Conference Proceedings;* **164**: No. 1, 459-462(10 Dec 1987). (CONF-870970—).

From 5. international conference on nuclei far from stability; Lake Rosseau, Canada (14 Sep 1987).

An investigation of the β^- decay of /sup 143/Cs and /sup 147/La was undertaken at the on-line mass separator TRISTAN. E/sub γ/, I/sub γ/ γ—γ coincidences, and γ—γ angular correlations were measured. Level schemes for /sup 143/Ba and /sup 147/Ce were constructed with proposed spin and parity assignments based upon measured transition multipolarities and γ—γ angular correlation coefficients.

23598 **Radioactivities with $146 \leqq A \leqq 152$ investigated at the OASIS facility; evidence for /sup 147/Tm β-decay.** Toth, K.S.; Nitschke, J.M.; Wilmarth, P.A.; Ellis-Akovali, Y.A.; Sousa, D.C.; Vierinen, K.; Moltz, D.M.; Gilat, J.; Rao, N.M. (Oak Ridge National Laboratory, Oak Ridge, TN 37831). *AIP (American Institute of Physics) Conference Proceedings;* **164**: No. 1, 718-721(10 Dec 1987). (CONF-870970—). Contract AC05-84OR21400;AC03-76SF00098.

From 5. international conference on nuclei far from stability; Lake Rosseau, Canada (14 Sep 1987).

A study of short-lived nuclei near the 82-neutron shell has been performed over the past two years at the SuperHILAC OASIS facility of Oak Ridge National Laboratory. Measurements of gamma, x-ray, and positron emission in coincidence with protons have been made and are discussed. (AIP)

6518 Nuclear Properties And Reactions, A=150-189, Experimental

23599 (INIS-BR—934, pp 86) **Coulomb excitation of /sup 189/Os.** Botelho, S.; Seale, W.A.; Ribas, R.V.; Cybulska, E.W.; Rao, M.N.; Medina, N.H.; Emediato, L.G.R.; Brandao, J.R.; Almeida, M. (Sao Paulo Univ., Brazil. Inst. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701471/JAW. (CONF-8708216—).

From 10. workshop on nuclear physics in Brazil; Caxambu, MG, Brazil (26 Aug 1987).

23600 (JINR—R-7-86-322, pp 42) **Dependence of angular momenta of nuclei - products of Hf + /sup 12/C incomplete fusion reaction with p and α-particle emission on incident ion energy.** Kamanin, V.V.; Kugler, A. 1986. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780065/JAW.

In Heavy ion physics - 1985. Collection of annotations of the Nuclear Reaction Laboratory of the Joint Nuclear Research Institute works, 1985.

23601 **(JINR-R—6-86-743) Beta decay of the /sup 164m/Tm ($T_1/2 = 5.1$min) isomer and the ^{164}Er excited level structure.** Adam, I.; Fer, I.; Dobesh, Ya.; Gons, Z.; Gromov, K.Ya. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1986. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87702985/JAW.

Submitted to the journal Izv. AN SSSR, Ser. Fiz.

The decay of /sup 164m/Tm nucleus has been studied by means of mass-separated sources. The single γ- and $\gamma\gamma$-coincidence spectra have been measured. The /sup 164m/Tm-> ^{164}Er decay scheme is proposed on the basis of the experimental data. Calculations of level energies and E2-transition probabilities are provided and are compared with experimental data. 27 references, 4 figures, 4 tables.

23602 (JINR—D-3,4,17-86-747, pp 70-89) **Two-quantum γ cascades in neutron capture by nuclei.** Popov, Yu.P.; Yazvitskij, Yu.S. 1987. (In Russian). NTIS (US Sales Only), PC A21/MF A01. Order Number DE88780064/JAW. (CONF-8610176—).

From 5. international school on neutron physics; Alushta, USSR (20 Oct 1986).

Data on investigation into two-quantum cascades of even-odd nuclei, produced after /sup 163/Dy, /sup 165/Dy, /sup 167/Er, /sup 175/Yb, /sup 179/Hf neutron capture from the neutron strength function 4s-maximum region, are presented. End level characteristics and data on cascades are presented in the form of tables in combination with theoretical values. The analysis shows, that experimental values of sum intensities of two-quantum cascades in all the nuclei, except /sup 163/Dy (and, pobably, /sup 167/Er) exceed theoretical evaluations about 1.5 times. The highest divergence is in /sup 179/Hf (1.9 +- 0.1). The value of cascade intensity calculated evaluation and experimental value divergence to a fixed end level is connected with the final state structure. 23 refs,; 7 figs.; 4 tabs.

6519 Nuclear Properties And Reactions, A=190-219, Experimental

23603 **(CERN-EP—86-187) Laser spectroscopy in regions of spherical and deformed nuclei.** Neugart, R. (Mainz Univ. (Germany, F.R.). Inst. fuer Physik; European Organization for Nuclear Research, Geneva (Switzerland)). 1986. 16p. (CONF-8609159—11). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88900420/JAW.

From International school-seminar on heavy ion physics; Dubna, USSR (23 Sep 1986).

Certain transitional as well as deformed regions of nuclei require a much more detailed view of the nuclear shape parameters. Two examples which have been investigated recently are discussed.

The first deals with the region beyond Z = 82 and N = 126, where there has been a continuing discussion about the nature of strong octupole correlations observed in the nuclear spectra. The second, on the contrary, deals with the nearly spherical Cd, Ni and Sn isotopes between the major neutron shell closures at N = 50 and N = 82. The laser spectroscopic results also include rich information about the ground (and isomeric) state spins and moments of which the latter are often only qualitatively reproduced by the pertinent model calculations. Here, the discussion is focussed on two nuclei of which the magnetic moments are of particular relevance for the nuclear structure: ^{207}Tl is the only heavy nucleus with a single s/sub 1/2/ proton state in a doubly magic core, and the very neutron-rich ^{11}Li - if not strongly deformed - should be doubly magic (Z = 2, N = 8) with a single p/sub 3/2/ valence proton. 60 refs., 7 figs.

23604 **(IPNO-DRE—87-12) Discussion of a new supersymmetry classification of nuclear levels in /sup 195/Pt.** Vergnes, M.; Berrier-Ronsin, G.; Rotbard, G. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). 1987. 5p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88752114/JAW.

New attributions of quantum numbers have been recently proposed for levels of /sup 195/Pt, on the basis of B(E2) and excitation energies. It is shown that the one neutron transfer reaction results reasonably support these attributions.

6520 Nuclear Properties And Reactions, A=220 And Above, Experimental

23605 (INIS-BR—934, pp 42) **Electrodisintegration of /sup 232//sub 90/Th by one neutron emission.** Terremoto, L.A.A.; Martins, M.N.; Wolynec, E. 1987. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701471/JAW. (CONF-8708216—).

From 10. workshop on nuclear physics in Brazil; Caxambu, MG, Brazil (26 Aug 1987).

23606 (INIS-BR—934, pp 46) **Photofission of uranium-238 in the quasi-deuteron region with monoenergetic and polarized photons.** Martins, J.B.; Tavares, O.A.P.; Oliveira, V.C. de; Pinheiro Filho, J.deD.; Schaerf, C.; D'Angelo, S.; Bernabei, R.; De Pascale, M.P. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro; Universidade Federal Fluminense, Niteroi, Brazil. Inst. de Fisica; Universita degli Studi di Roma, Italy; Instituto Nazionale de Fisica Nuclear, Frascati, Italy). 1987. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701471/JAW. (CONF-8708216—).

From 10. workshop on nuclear physics in Brazil; Caxambu, MG, Brazil (26 Aug 1987).

23607 (JINR—R-7-86-322, pp 11-13) **Experiments on the synthesis of the element 110 isotopes in the /sup 209/Bi + /sup 52/Co and /sup 232/Th + /sup 48/Ca reactions.** Oganesyan, Yu.P.; Demin, A.G.; Tret'yakova, S.P.; Utenkov, V.K.; Shirokovskij, I.V.; Ivanov, G.N. 1986. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780065/JAW.

In Heavy ion physics - 1985. Collection of annotations of the Nuclear Reaction Laboratory of the Joint Nuclear Research Institute works, 1985.

23608 (JINR—R-7-86-322, pp 19-20) **Experimental observation of the heavy nucleus spontaneous decay with neon nuclei emission.** Tret'yakova, S.P.; Sehndulesku, A.K.; Mikheev, V.L.; Khashegan, D.; Lebedev, I.A.; Korotkin, Yu.S.; Zamyatnin, Yu.S.; Myasoedov, B.F. 1986. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780065/JAW.

In Heavy ion physics - 1985. Collection of annotations of the Nuclear Reaction Laboratory of the Joint Nuclear Research Institute works, 1985.

23609 (JINR—R-7-86-322, pp 21) **/sup 24/Ne nucleus emission in the reactions with low-energy γ-quanta.** Gangrskij, Yu.P.; Khristov, Kh.G.; Bas'ko, V.M. 1986. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780065/JAW.

In Heavy ion physics - 1985. Collection of annotations of the Nuclear Reaction Laboratory of the Joint Nuclear Research Institute works, 1985.

23610 (JINR—R-7-86-322, pp 30) **Californoim-249 half-life relative to spontaneous fission.** Tarantin, N.I.; Buklanov, G.V.; Kim Su Men; Korotkin, Yu.S. 1986. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780065/JAW.

In Heavy ion physics - 1985. Collection of annotations of the Nuclear Reaction Laboratory of the Joint Nuclear Research Institute works, 1985.

23611 (JINR—R-7-86-322, pp 36) **Strong-asymmetrical fission of nuclei produced in thorium irradiation by alpha particles and deuterons.** Oganesyan, Yu.Ts.; Gehrbish, Sh.; Lobanov, Yu.V.; Korotkin, Yu.S.; Yussonua, M. 1986. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780065/JAW.

In Heavy ion physics - 1985. Collection of annotations of the Nuclear Reaction Laboratory of the Joint Nuclear Research Institute works, 1985.

23612 (JINR—R-7-86-322, pp 43) **Experiment on determination of the /sup 22/Ne + /sup 238/U fission reaction duration.** Bugrov, V.N.; Vinogradov, V.G.; Karamyan, S.A. 1986. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780065/JAW.

In Heavy ion physics - 1985. Collection of annotations of the Nuclear Reaction Laboratory of the Joint Nuclear Research Institute works, 1985.

23613 (JINR—R-7-86-322, pp 44) **Angular fragment distribution and fission reaction duration.** Karamyan, S.A.; Bugrov, V.N.; Spiridonov, V.I. 1986. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780065/JAW.

In Heavy ion physics - 1985. Collection of annotations of the Nuclear Reaction Laboratory of the Joint Nuclear Research Institute works, 1985.

23614 (JINR—R-7-86-322, pp 47) **Correlation experiments with α-particle and two fission fragments detection.** Mezentsev, A.N.; Artyukh, A.G.; Volkov, V.V.; Gridnev, G.F.; Karch, V.; Mikheev, V.L. 1986. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780065/JAW.

In Heavy ion physics - 1985. Collection of annotations of the Nuclear Reaction Laboratory of the Joint Nuclear Research Institute works, 1985.

23615 (JINR—R-7-86-322, pp 48) **Light nucleus escape in the /sup 181/Ta + /sup 52/Cr(400 MeV), /sup 197/Au + /sup 40/Ar(300 MeV), /sup 232/Th + /sup 14/N(110 MeV) reactions.** Mezentsev, A.N.; Artyukh, A.G.; Volkov, V.V. 1986. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780065/JAW.

In Heavy ion physics - 1985. Collection of annotations of the Nuclear Reaction Laboratory of the Joint Nuclear Research Institute works, 1985.

23616 (JINR—R-7-86-322, pp 49) **To problem on the increased yield of evaporation α particles in heavy ion reactions.** Volkov, V.V.; Ershov, S.N.; Ivanova, S.P. 1986. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780065/JAW.

In Heavy ion physics - 1985. Collection of annotations of the Nuclear Reaction Laboratory of the Joint Nuclear Research Institute works, 1985.

23617 **(LA-UR—88-592) Development of a rapid radiochemical procedure for the separation of /sup 235m/U from ^{239}Pu.** Attrep, M. Jr.; Efurd, D.W.; Roensch, F.R. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 12p. (CONF-871270—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006454/JAW.

From Symposium on nuclear, geo- and cosmochemistry; Little Rock, AR, USA (2 Dec 1987).

We have developed a rapid radiochemical procedure for the isolation and purification of /sup 235m/U (t/sub 1/2/ = 26 minutes) from ^{239}Pu samples up to 250 mg. Purpose of developing the procedure was to measure the thermal neutron fission cross section of the isomeric meta state of ^{235}U. We used rapid small-scale anion exchange columns that absorbed uranium in concentrated HBr but did not absorb plutonium. Uranium was easily eluted with very dilute HF. The separation time required 25 to 35 minutes. We were able to attain a separation factor of uranium from plutonium of approximately 1 x 10^{10} with samples ranging from 1 x 10^{10} to 3 x 10^{11}. The ratio of the fission cross sections for the meta to ground state was measured to be 1.42. 4 figs., 1 tab.

23618 **(NEANDC(J)—126/U) Evaluation of neutron nuclear data for ^{252}Cf and ^{250}Bk.** Nakagawa, Tsuneo. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Feb 1988. 38p. (JAERI-M—88-004; INDC(JPN)—112/L). JAERI, Tokai-mura, Naka-gun, Ibaraki-ken 319-11, Japan. Order Number TI88900373/JAW.

Neutron nuclear data of ^{252}Cf and ^{250}Bk have been evaluated in the neutron energy range from 10^{-5} eV to 20 MeV. The cross sections evaluated are the total, elastic and inelastic scattering, (n,2n), (n,3n), (n,4n) reaction, fission and capture cross sections. For the both nuclides, cross sections below 30 keV were represented with resolved and unresolved resonance parameters. For ^{252}Cf, the resolved resonance parameters were evaluated in the energy range from 10^{-5} eV to 1 keV and the unresolved resonance parameters above 1 keV. For ^{250}Bk, no resonance parameters have been reported. Therefore, hypothetical resolved resonance parameters were given below 100 eV. In addition, angular and energy distributions of emitted neutrons and average number of emitted neutrons per fission were also evaluated. Existing experimental data are only those for the fission cross section of ^{252}Cf, thermal cross sections and resonance integrals of ^{252}Cf and the fission cross section of ^{250}Bk at the thermal neutron energy. The present evaluation, therefore, was mainly based on the systematics of the data from neighboring nuclides and optical- and statistical-model calculations.

23619 **Heavy fragment radioactivities.** Price, P.B. (Physics Department, University of California, Berkeley, CA 94720). *AIP (American Institute of Physics) Conference Proceedings;* **164**: No. 1, 800-809(10 Dec 1987). (CONF-870970—).

From 5. international conference on nuclei far from stability; Lake Rosseau, Canada (14 Sep 1987).

This recently discovered mode of radioactive decay, like alpha decay and spontaneous fission, is believed to involve tunneling through the deformation-energy barrier between a very heavy nucleus and two separated fragments the sum of whose masses is less than the mass of the parent nucleus. In all known cases the heavier of the two fragments is close to doubly magic /sup 208/Pb, and the lighter fragment has even Z. Four isotopes of Ra are known to emit /sup 14/C nuclei; several isotopes of U as well as /sup 230/Th and /sup 231/Pa emit Ne nuclei; and /sup 234/U exhibits four hadronic decay modes: alpha decay, spontaneous fission, Ne decay and Mg decay.

23620 **Evidence for bimodal fission in the heaviest elements.** Hulet, E.K. (University of California, Lawrence Livermore National Laboratory, Livermore, CA 94550). *AIP (American Institute of Physics) Conference Proceedings;* **164**: No. 1, 810-820(10 Dec 1987). (CONF-870970—). Contract W-7405-ENG-48.

From 5. international conference on nuclei far from stability; Lake Rosseau, Canada (14 Sep 1987).

We have measured the mass and kinetic-energy partitioning in the spontaneous fission of five heavy nuclides: /sup 258/Fm, /sup 259/Md, /sup 260/Md, /sup 258/No, and /sup 260/(104). Each was produced by heavy-ion reactions with either /sup 248/Cm, /sup 249/Bk, or /sup 254/Es targets. Energies of correlated fragments from the isotopes with millisecond half lives, /sup 258/No and /sup 260/[104], were measured on-line by a special rotating-wheel instrument, while the others were determined off-line after mass separation. All fissioned with mass distributions that were symmetric. Total-kinetic-energy distributions peaked near either 200 or 235 MeV. Surprisingly, because only a single Gaussian energy distribution had been observed previously in actinide fission, these energy distributions were skewed upward or downward from the peak in each case, except for /sup 260/[104], indicating a composite of two energy distributions. We were able to fit accurately two Gaussian curves to the gross energy distributions from the four remaining nuclides. From the multiple TKE distributions and the shapes of the mass distributions, we conclude that there is a low-energy fission component with liquid-drop characteristics which is admixed with a much higher-energy component due to closed fragment shells. We now have further evidence for this conclusion from measurements of the neutron multiplicity in the spontaneous fission of /sup 260/Md.

23621 **(JINR—D-3,4,17-86-747, pp 61-69) Variation of mean square nuclear radii of uranium isotopes in resonance neutron capture.** Zajdel', K.; Pikel'ner, L.B. (Technische Univ., Dresden, German Democratic Republic; Joint Inst. for Nuclear Research, Dubna, USSR). 1987. (In Russian). NTIS (US Sales Only), PC A21/MF A01. Order Number DE88780064/JAW. (CONF-8610176—).

From 5. international school on neutron physics; Alushta, USSR (20 Oct 1986).

A new trend in studying the properties of the nucleus compound states, based on measuring the neutron resonance chemical shifts, has resently developed. Experiments, in which the changes of /sup 234/U, /sup 235/U, /sup 238/U uranium isotope nucleus charge mean square radii were investigated are considered. Question, concerning the connection of mean square radius change with nucleus fissility, is discussed. Besides, methodically relative phenomenon of neutron resonance temperature shift is considered. 13 refs.; 5 figs.

6530 Nuclear Theory

REFER ALSO TO CITATION(S) 22230, 22462, 22495, 23467, 23555, 23561, 23563, 23566, 23618, 23618, 23818

23622 **(AD-A—187166/4/XAB) Nuclear excitation via the motion of electrons in a strong laser field. Final report.** Berger, J.F.; Gogny, D.; Weiss, M.S. (Lawrence Livermore National Lab., CA (USA)). Jun 1987. 48p. (UCRL—96759). NTIS, PC A03/MF A01.

A method of switching from a nuclear isomeric state to a lasing state is examined. A semi-classical model of laser-electron-nuclear coupling is developed. In it the electrons are treated as free in the external field of the laser, but with initial conditions corresponding to their atomic orbits. Application is made to testing this model in U-235 and to the design criteria of a gamma-ray laser.

23623 **(ATOMKI-A—21(1987)) Proton-neutron multiplet states of light odd-odd In and Sb nuclei.** Fenyes, Tibor; Dombradi, Zsolt; Krasznahorkay, A.; Kibedi, T.; Timar, J. (Magyar Tudomanyos Akademia, Debrecen. Atommag Kutato Intezete). 1987. 27p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number TI88701715/JAW.

/sup 114,112,110,108,106/In nuclei were studied by in-beam gamma and electron spectroscopy in proton and alpha induced reactions. The energy splitting of proton-neutron states of /sup 116,114,112,110/In and /sup 122,120/Sb nuclei was studied using the parabolic rule derived from the cluster-vibrational model. The parabolic rule gives a good description of the known energy levels. Quantum states of /sup 114/In were analyzed in detail. Nuclear wave functions and magnetic dipole moments were calculated by OTQM computer code. The results are in good agreement with the experimental data. (D.Gy.).

23624 (ATOMKI-A—23(1987)) Fragmentation properties of /sup 6/Li. Lovas, R.G.; Kruppa, A.T.; Beck, R.; Dickmann, F. (Magyar Tudomanyos Akademia, Debrecen. Atommag Kutato Intezete; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Kernphysik 3). (Magyar Tudomanyos Akademia, Debrecen. Atommag Kutato Intezete). 1987. 60p. NTIS (US Sales Only), PC A04/MF A01. Order Number TI88701716/JAW.

Submitted to Nucl. Phys., A (NL).

The α+d and t+tau cluster structure of /sup 6/Li is described in a microscopic α+d cluster model through quantities that enter into the description of cluster fragmentation processes. The states of the separate clusters α, d, t and tau are described as superpositions of Os Slater determinants belonging to different potential size parameters. To describe both the /sup 6/Li and fragment state realistically, nucleon-nucleon forces optimized for the used model state spaces were constructed. The fragmentation properties predicted by them slightly differ from those calculated with some forces of common use provided the latter are modified so as to reproduce the α, d and /sup 6/Li energies. (author) 61 refs.; 9 figs.

23625 (DOE/ER/40145—2) [Research in theoretical nuclear physics]: Progress in research, November 1, 1986-October 31, 1987. (Texas Univ., Austin (USA). Dept. of Physics). Nov 1987. Contract FG05-84ER40145. 58p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88006063/JAW.

This paper discusses research in theoretical nuclear physics in the following areas: reactions induced by light ions, reactions induced by heavy ions, medium energy physics and nuclear collective motions. 14 figs. (LSP)

23626 (GANIL-P—87-22) Some aspects of nuclear dynamics. Gregoire, C. (Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France)). 1987. 47p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752110/JAW.

First the BBGKY hierarchy of equations is presented; the method developed here lies on a reduction procedure of a many body density distribution function. From the equations, Hartree and Hartree-Fock approximations are deduced, and time dependent Hartree-Fock equation. Then two derivations of a nuclear reaction kinetic equation are presented: the Woldmann-Snider equation and the Botermans-Malfliet equation. The Wigner transformation is used and the Landau-Vlasov equation is studied. (Or Vlasov-Uehling-Uhlenbeck or Boltzmann-Uehling-Uhlenbeck equation). Keypoints of approximate solutions are mentioned. Simulation calculations of phenomenological collisions are shown. Then dynamics of heavy ion reactions is studied from results presented.

23627 (GSI—87-18) Dissipative fluid mechanics of nuclei. Morgenstern, B. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Technische Hochschule Darmstadt (Germany, F.R.). Fachbereich 5 - Physik). Nov 1987. 85p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number TI88752465/JAW.

With the aim to describe nucleus-nucleus collisions at low energies in the present thesis for the first time dissipative fluid dynamics for large-amplitude nuclear motion have been formulated. Thereby the collective dynamics are described in a scaling approximation in which the wave function of the system is distorted by a vortex-free velocity field. For infintely extended nuclear matter this scaling of the wave functions leads to a deformation of the Fermi sphere. Two-body collisions destroy the collective deformation of the Fermi sphere and yield so the dissipative contribution of the motion. Equations of motion for a finite set of collective variables and a field equation for the collective velocity potential in the limit of infinitely many degrees of freedom were developed. In the elastic limit oscillations around the equilibrium position are described. For small collective amplitudes and vortex-free velocity fields the integrodifferential equation for the velocity potential in the elastic limit could be transformed to the divergence of the field equation of fluid dynamics. In the dissipative limit an equation results which is similar to the Navier-Stokes equation and transforms to the divergence of the Navier-Stokes equation for vortex-free fields. It was shown that generally the dynamics of the many-body system is described by non-Markovian equations. (orig./HSI).

23628 (IFUSP-P—622) Scattering in particle-hole space: simple approximations to nuclear RPA calculations in the continuum. Toledo Piza, A.F.R. de. (Sao Paulo Univ. (Brazil). Inst. de Fisica). Jan 1987. 17p. NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701580/JAW.

The Random Phase Approximation (RPA) treatment of nuclear small amplitude vibrations including particle-hole continua is handled in terms of previously developed techniques to treat single-particle resonances in a reaction theoretical framework. A hierarchy of interpretable approximations is derived and a simple working approximation is proposed which involves a numerical effort no larger than that involved in standard, discrete RPA calculations.

23629 (INDC(VN)—006/L) Preequilibrium emission of protons and isotopic effect in the fast neutron-induced (n,p) reactions on heavy elements. Hien, P.Z.; Lien, H.N. (National Inst. for Atomic Energy (Viet Nam)). (International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee). Dec 1987. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701740/JAW.

The 14 MeV neutron-induced (n,p) reaction cross-sections for the isotopes of Sm, Dy and Er have been calculated using the preequilibrium exciton + compound nucleus evaporation models. For a given element, as the neutron number of the isotopes increases, the (n,p) reaction cross-section decreases exponentially with the reaction Q-value corrected for the pairing energy of the residual nucleus. More than 85% of the preequilibrium protons are emitted from the exciton state n=3. Based on this result an analytical formula has been found for calculations of the (n,p) reaction cross-sections of the heavy isotopes. (author). 11 refs, 4 figs, 1 tab.

23630 (INIS-BR—934) Proceedings of the 10. Workshop on Nuclear Physics in Brazil. (Sociedade Brasileira de Fisica, Sao Paulo). 1987. 172p. (In Portuguese). (CONF-8708216—). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701471/JAW.

From 10. workshop on nuclear physics in Brazil; Caxambu, MG, Brazil (26 Aug 1987).

Theoretical and experimental studies on Nuclear Physics are presented. Nuclei structures, nuclear reaction cross sections, collision phenomena between particles at several energy ranges and radiation effects on solids and liquids are analysed. (M.C.K.).

23631 (INIS-BR—934, pp 20) S/sub p/(1,R) model in a deformed phase, applied to /sup 8/Be. Avancini, S.S.; Passos, E.J.V. de. (Sao Paulo Univ., Brazil. Inst. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701471/JAW. (CONF-8708216—).

From 10. workshop on nuclear physics in Brazil; Caxambu, MG, Brazil (26 Aug 1987).

23632 (INIS-BR—934, pp 23) Nuclear interaction in the spin-isospin channel. Salvetti, A.R.; Toledo Piza, A.F.R. de. (Mato Grosso do Sul Univ., Campo Grande, Brazil. Dept. de Fisica; Sao Paulo Univ., Brazil. Inst. de Fisica). 1987. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701471/JAW. (CONF-8708216—).

From 10. workshop on nuclear physics in Brazil; Caxambu, MG, Brazil (26 Aug 1987).

23633 (INIS-BR—934, pp 26) Effect of nuclear deformation in the density of exciton states. Rego, R.A.; Reffo, G.; Herman, M. (Centro Tecnico Aeroespacial, Sao Jose dos Campos, Brazil. Inst. de Estudos Avancados; Ente Nazionale Energie Alternative, Bolonha, Italy). 1987. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701471/JAW. (CONF-8708216—).

From 10. workshop on nuclear physics in Brazil; Caxambu, MG, Brazil (26 Aug 1987).

23634 (INIS-BR—934, pp 29) **Hybrid method for calculating energy level densities of particle-hole.** Carlson, B.V.; Merchant, A.C. (Centro Tecnico Aeroespacial, Sao Jose dos Campos, Brazil. Inst. de Estudos Avancados). 1987. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701471/JAW. (CONF-8708216—).

From 10. workshop on nuclear physics in Brazil; Caxambu, MG, Brazil (26 Aug 1987).

23635 (INIS-BR—934, pp 33) **Density of particle-hole state transitions.** Carlson, B.V.; Frederico, T.; Merchant, A.C.; Rego, R.A. (Centro Tecnico Aeroespacial, Sao Jose dos Campos, Brazil. Inst. de Estudos Avancados). 1987. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701471/JAW. (CONF-8708216—).

From 10. workshop on nuclear physics in Brazil; Caxambu, MG, Brazil (26 Aug 1987).

23636 (INIS-BR—934, pp 39) **Semiclassical approximation by cumulant method: the Strutinskii prescription.** Galetti, D.; Mizrahi, S.S. (Instituto de Fisica Teorica, Sao Paulo, Brazil; Sao Carlos Univ., Brazil). 1987. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701471/JAW. (CONF-8708216—).

From 10. workshop on nuclear physics in Brazil; Caxambu, MG, Brazil (26 Aug 1987).

23637 (INIS-BR—934, pp 77) **Rotating elliptical billiard: is it a problem for the nuclear physics.** Bernath, M.; Fendrik, A.J.; Leboeuf, P.; Perazzo, R.P.J.; Saraceno, M. 1987. (In Spanish). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701471/JAW. (CONF-8708216—).

From 10. workshop on nuclear physics in Brazil; Caxambu, MG, Brazil (26 Aug 1987).

23638 (INIS-BR—934, pp 98) **Generation of rotational bands by deep, diffuse potentials.** Merchant, A.C. (Centro Tecnico Aeroespacial, Sao Jose dos Campos, Brazil. Inst. de Estudos Avancados). 1987. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701471/JAW. (CONF-8708216—).

From 10. workshop on nuclear physics in Brazil; Caxambu, MG, Brazil (26 Aug 1987).

23639 (INIS-BR—934, pp 101) **Alpha particle cluster states in /sup 40/Ca.** Merchant, A.C. 1987. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701471/JAW. (CONF-8708216—).

From 10. workshop on nuclear physics in Brazil; Caxambu, MG, Brazil (26 Aug 1987).

23640 (INIS-BR—934, pp 104) **Simplified description of multiple emission of the compound nucleus.** Carlson, B.V. (Centro Tecnico Aeroespacial, Sao Jose dos Campos, Brazil. Inst. de Estudos Avancados). 1987. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701471/JAW. (CONF-8708216—).

From 10. workshop on nuclear physics in Brazil; Caxambu, MG, Brazil (26 Aug 1987).

23641 (INIS-BR—934, pp 116) **Calculation of D/S ratio for /sup 4/He.** Frederico, T.; Adhikari, S.K.; Goldman, I.D. (Centro Tecnico Aeroespacial, Sao Jose dos Campos, Brazil. Inst. de Estudos Avancados; Pernambuco Univ., Recife, Brazil. Dept. de Fisica; Sao Paulo Univ., Brazil. Inst. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701471/JAW. (CONF-8708216—).

From 10. workshop on nuclear physics in Brazil; Caxambu, MG, Brazil (26 Aug 1987).

23642 (INIS-BR—934, pp 119) **Calculation of polarization with N-N separable potential.** Frederico, T.; Goldman, I.D.; Adhikari, S.K. (Centro Tecnico Aeroespacial, Sao Jose dos Campos, Brazil. Inst. de Estudos Avancados; Sao Paulo Univ., Brazil. Inst. de Fisica; Pernambuco Univ., Recife, Brazil. Dept. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701471/JAW. (CONF-8708216—).

From 10. workshop on nuclear physics in Brazil; Caxambu, MG, Brazil (26 Aug 1987).

23643 (INIS-BR—934, pp 108) **Are the relativistic effects essential for nuclear matter saturation in the γ-W model.** Nemes, M.C.; Goncalves, E. (Sao Paulo Univ., Brazil. Inst. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701471/JAW. (CONF-8708216—).

From 10. workshop on nuclear physics in Brazil; Caxambu, MG, Brazil (26 Aug 1987).

23644 (INIS-BR—934, pp 1) **Charge-exchange reactions.** Etchegoyen, A. (Comision Nacional de Energia Atomica, Buenos Aires, Argentina). 1987. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701471/JAW. (CONF-8708216—).

From 10. workshop on nuclear physics in Brazil; Caxambu, MG, Brazil (26 Aug 1987).

23645 (INIS-BR—934, pp 2) **Determination of the reaction cross section for heavy ion systems.** Lepine-Szily, A.; Villari, A.C.C.; Oliveira Junior, J.M.; Lichtenthaler Filho, R.; Obuti, M.M.; Portezan Filho, O.; Added, N. (Sao Paulo Univ., Brazil. Inst. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701471/JAW. (CONF-8708216—).

From 10. workshop on nuclear physics in Brazil; Caxambu, MG, Brazil (26 Aug 1987).

23646 (INIS-BR—934, pp 8) **Study of peripheral processes in /sup 16/O+6/sup 3/,/sup 65/Cu systems.** Ramirez, G.; Pereira, D.; Sala, O.; Gomes, L.C. (Chile Univ., Santiago. Facultad de Ciencias; Sao Paulo Univ., Brazil. Inst. de Fisica; Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1987. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701471/JAW. (CONF-8708216—).

From 10. workshop on nuclear physics in Brazil; Caxambu, MG, Brazil (26 Aug 1987).

23647 (INIS-BR—934, pp 54) **Thermal capture cross sections of the /sup 58/Ni(n,γ)/sup 59/Ni reaction.** Carbonari, A.W.; Pecequilo, B.R.S. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, Brazil. Div de Fisica Nuclear). 1987. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701471/JAW. (CONF-8708216—).

From 10. workshop on nuclear physics in Brazil; Caxambu, MG, Brazil (26 Aug 1987).

23648 (INIS-BR—934, pp 65) **Nuclear fragmentation: percolation by tetrahedron.** Chao, N.-C.; Chung, K.C. (Rio Grande do Norte Univ., Natal, Brazil. Dept. de Fisica; Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1987. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701471/JAW. (CONF-8708216—).

From 10. workshop on nuclear physics in Brazil; Caxambu, MG, Brazil (26 Aug 1987).

23649 (INIS-BR—934, pp 68) **Determination of kinetic coefficients for proton-nucleus reactions at high energies.** Nemes, M.C.; Rizzato, C.M. (Sao Paulo Univ., Brazil. Inst. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701471/JAW. (CONF-8708216—).

From 10. workshop on nuclear physics in Brazil; Caxambu, MG, Brazil (26 Aug 1987).

23650 (INIS-BR—934, pp 71) **Model of pre-equilibrium reactions.** Carlson, B.V. (Centro Tecnico Aeroespacial, Sao Jose dos Campos, Brazil). 1987. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701471/JAW. (CONF-8708216—).

From 10. workshop on nuclear physics in Brazil; Caxambu, MG, Brazil (26 Aug 1987).

23651 (INIS-BR—934, pp 76) **Gaussian approximation of Fokker-Planck equation discussed in terms of the Langevin simulation.** Pato, M.P.; Gomes, L.C. (Sao Paulo Univ., Brazil. Inst. de Fisica; Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1987. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701471/JAW. (CONF-8708216—).

From 10. workshop on nuclear physics in Brazil; Caxambu, MG, Brazil (26 Aug 1987).

23652 (INIS-BR—934, pp 78) **Fusion and quasi-elastic processes near the columbus barrier: /sup 16/O +/sup a/Sm systems.** Abriola, D. (Comision Nacional de Energia Atomica, Buenos Aires, Argentina). 1987. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701471/JAW. (CONF-8708216—).

From 10. workshop on nuclear physics in Brazil; Caxambu, MG, Brazil (26 Aug 1987).

23653 (INIS-BR—934, pp 92) **Measurement of cross section for the /sup 18/O + /sup 10/B reaction.** Added, N.; Carlin Filho, N.; Coimbra, M.M.; Anjos, R.M. dos; Guimaraes, V.; Szanto, E.M.; Figueira, M.C.S.; Fante Junior, L.; Toledo, A.S. de. 1987. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701471/JAW. (CONF-8708216—).

From 10. workshop on nuclear physics in Brazil; Caxambu, MG, Brazil (26 Aug 1987).

23654 (INIS-BR—934, pp 95) **Effects of α-polarization in the /sup 16/O+/sup 24/Mg reaction.** Lichtenthaler Filho, R.; Lepine-Szily, A.; Villari, A.C.C.; Martins Junior, J.; Obuti, M.M. (Sao Paulo Univ., Brazil. Inst. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701471/JAW. (CONF-8708216—).

From 10. workshop on nuclear physics in Brazil; Caxambu, MG, Brazil (26 Aug 1987).

23655 (INIS-mf—11631) **Semiclassical theory for the nuclear response function. Quasi-elastic electron scattering.** Stroth, U. (Technische Hochschule Darmstadt (Germany, F.R.). Fachbereich 5 - Physik). 6 May 1986. 153p. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number TI88752475/JAW.

In the first part of this thesis it was demonstrated how on a semiclassical base a RPA theory is developed and applied to electron scattering. It was shown in which fields of nuclear physics this semiclassical theory can be applied and how it is to be understood. In this connection we dedicated an extensive discussion to the Fermi gas model. From the free response function we calculated the RPA response with a finite-range residual interaction which we completely antisymmetrize. In the second part of this thesis we studied with our theory (e,e') data for the separated response functions. (orig./HSI).

23656 (ITEP—140(1986)) **Virtual and resonance levels in screened Coulomb potentials.** Orlov, Yu.V.; Turovtsev, V.V.; Popov, V.S.; Weinberg, V.M. (Moskovskij Gosudarstvennyj Univ. (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki; Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1986. 28p. NTIS (US Sales Only), PC A03/MF A01. Order Number TI88701649/JAW.

Two methods for computation of real, virtual and quasistationary energy eigenvalues are considered: summation of divergent perturbation series, solution of integral equations for t matrix on physical and nonphysical sheets of energy. The results of energy computation for s-, p- and d-states in potentials of a screened Coulomb type are presented. It is shown on an example of the Yukawa potential that the energy eigenvalues given by both these methods coincide with high precision. As an illustration the positions of real (deuteron) and virtual (singlet deuteron) poles of the np-scattering amplitude are calculated. For Yukawa type potentials the new theorem of symmetry for bound and virtual levels is discussed. 25 refs.; 5 figs.; 4 tabs.

23657 (JINR—R-4-86-843) **Coupled channels in the boundary condition model.** Shilov, V.M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1986. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701163/JAW.

It is shown, that the multichannel model with boundary conditions, in the form of converging wave in the internal region of the nucleus appear to be a good basis for describing reactions with heavy ions at near - and subbarrier energies. Channels of elastic, inelastic scattering and fusion as well as spontaneous nuclear decay with heavy cluster yield are considered. Methodical calculations for coefficient of tunneling probability amplification due to strong coupling with inelastic channels are performed. 19 refs.; 3 figs.

23658 (JINR—R-7-86-322, pp 45) **Total fusion process of nuclei in view of data on nucleus interaction in deep inelastic transfers.** Volkov, V.V. 1986. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780065/JAW.

In Heavy ion physics - 1985. Collection of annotations of the Nuclear Reaction Laboratory of the Joint Nuclear Research Institute works, 1985.

23659 (JINR—R-7-86-322, pp 46) **Centrifugal fragmentation as a new kind of nuclear reactions with heavy ions.** Volkov, V.V. 1986. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780065/JAW.

In Heavy ion physics - 1985. Collection of annotations of the Nuclear Reaction Laboratory of the Joint Nuclear Research Institute works, 1985.

23660 (JINR—R-7-86-322, pp 37) **Cluster evaporation from excited compound nuclei.** Muzychka, Yu.A.; Pustyl'nik, B.I. 1986. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780065/JAW.

In Heavy ion physics - 1985. Collection of annotations of the Nuclear Reaction Laboratory of the Joint Nuclear Research Institute works, 1985.

23661 (JINR-E—1-86-578) **Formulas for description of nucleon emission intensity in hadron-nucleus collisions.** Strugalski, Z. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1986. 8p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87702968/JAW.

Formulas for description of the nucleon emission intensity in hadron-nucleus collisions, in terms of the data on the target nucleus size and nucleon density distribution in atomic nuclei, are obtained on the basis of experimental data available. The formulas presented are not simple fittings of the data, they are based on physical motivation only, and do not contain free parameters. Formulas contain A-, energy- and hadron identity-dependences, and are valid at inci-

dent hadron energy over the pion production threshold. 21 references.

23662 (JINR-E—4-86-658) Giant monopole transition densities within the local scale ATDHF approach. Dimitrova, S.S.; Petkov, I.Zh.; Stoitsov, M.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1986. 13p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87702970/JAW.

Transition densities for ^{12}C, ^{16}O, ^{28}Si, ^{32}S, ^{40}Ca, ^{48}Ca, ^{56}Ni, ^{90}Zr, ^{208}Pb even-even nuclei corresponding to nuclear glant monopole resonances obtained within a local-scale adiabatic time-dependent Hartree-Fook approach in terms of effective Skyrme-type forces SkM and S3. The approach, the particular form and all necessary coefficients of these transition densities are reported. They are of a simple analytical form and may be directly used for example in analyses of particle inelastic scattering on nuclei by distorted wave method and a such a way allowing a test of the theoretical interpretation of giant monopole resonances. 20 references, 4 tables.

23663 (JINR-R—4-87-262) Calculation of real optical model potential for heavy ions in the framework of the folding model. Goncharov, S.A.; Timofeyuk, N.K.; Kazacha, G.S. (Moskovskij Gosudarstvennyj Univ. (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki; Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701665/JAW.

The code for calculation of a real optical model potential in the framework of the folding model is realized. The program of numerical Fourier-Bessel transformation based on Filon's integration rule is used. The accuracy of numerical calculations is ~ 10/sup -4/ for a distance interval up to a bout (2.5-3) times the size of nuclei. The potentials are calculated for interactions of /sup 3,4/He with nuclei from /sup 9/Be to /sup 27/Al with different effective NN-interactions and densities obtained from electron scattering data. Calculated potentials are similar to phenomenological potentials in Woods-Saxon form. With calculated potentials the available elastic scattering data for the considered nuclei in the energy interval 18-56 MeV are analysed. The needed renormalizations for folding potentials are <or approx. 20%. 15 refs.; 3 figs.; 5 tabs.

23664 (KFKI—1987-52/A) Interpretable family of equations of state for dense hadronic matter. Zimanyi, J.; Lukacs, B.; Levai, P.; Bondorf, J.P.; Balazs, N.L. (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics; Niels Bohr Inst., Copenhagen (Denmark); New York Univ., NY (USA). Dept. of Physics). (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). Aug 1987. 15p. NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701766/JAW.

A new family of equations of state for hadronic matter is presented which is consistent with nuclear matter properties at normal nuclear densities and at high densities produced in heavy ion collisions. This description contains interacting nucleons with free mass and reasonable single particle distributions, thus allowing reliable hadrochemical calculations.

23665 (KIYI—86-38) About the role of direct peripheral reactions in heavy ion elastic scattering. Pozdnyakov, Yu.A.; Terenetskij, K.O. (AN Ukrainskoj SSR, Kiev. Inst. Yadernykh Issledovanij). 1986. 37p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number TI88701686/JAW.

The influence of the direct peripheral reactions on the heavy-ion differential cross sections is investigated in the frame of the incoming wave boundary condition model of elastic scattering. The elastic scattering of /sup 16/O on /sup 208/Pb, /sup 88/Sr, /sup 40/Ca and /sup 28/Si is investigated. It is shown that the analysis of the elastic scattering data permits to determine the total cross sections of the direct peripheral reactions and thus to estimate the contribution of direct reaction mechanism to the total reaction cross sections. Necessity of taking into account the direct peripheral reactions in analysis of fusion is pointed out. 30 refs.; 11 figs.; 5 tabs.

23666 (KIYI—86-42) Determination of intermediate nucleus polarization of three-particle nuclear reaction according to angular correlation of its products. Kozyr', Yu.E.; Sokolov, M.V. (AN Ukrainskoj SSR, Kiev. Inst. Yadernykh Issledovanij). 1986. 17p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701203/JAW.

Based on a general theory of angular correlation of particles in nuclear reaction the relations are obtained to express the components of statistical polarization tensor of intermediate nucleus via experimentally measured values of angular correlation of reaction products. A computer programme of processing of correlation data is worked out for the value definition of components of polarization tensor and its standard deviations. The texts are given on corresponding programme units in FORTRAN. The examples of programme use to the specific sets of experimental data are considered for reactions α+/sup 6/Li -> α+α+d and α+/sup 7/Li -> α+α+t. An importance of regular choice of measurement geometry is shown for the reliability of calculating result. 5 refs.; 2 tabs.

23667 (LA-UR—88-153) Fragmentation and flow in central collisions. Jacak, B.V.; Doss, K.G.R.; Gustafsson, H.A.; Gutbrod, H.; Harris, J.W.; Kampert, K.H.; Kolb, B.; Poskanzer, A.M.; Ritter, H.G.; Schmidt, H.R. (Los Alamos National Lab., NM (USA); Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Lawrence Berkeley Lab., CA (USA)). 1987. Contract W-7405-ENG-36. 15p. (CONF-871243—5). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005386/JAW.

From Symposium on hot nuclei; College Station, TX, USA (7 Dec 1987).

Investigation of the fragmentation mechanism requires the measurement of complicated observables. To identify what part of the reacting system gives rise to the fragments, it would be useful to tag them as participants or spectators. A large acceptance for all the reaction products and an event-by-event measurement of the fragment multiplicity is required to distinguish fragment formation via sequential emission from a large equilibrated system and multifragmentation. In order to address whether fragments are formed early or late in the collision, information about the dynamical evolution of the reaction is necessary. This can be provided by study of the global properties of the events. This paper discusses experimental techniques applicable to studying fragmentation processes. 25 refs., 8 figs.

23668 (LBL—24398) Heavy ion physics challenges at Bevalac/SIS energies. Gyulassy, M. (Lawrence Berkeley Lab., CA (USA)). Nov 1987. Contract AC03-76SF00098. 12p. (CONF-8711116—5). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005751/JAW.

From 8. high energy heavy ion study; Berkeley, CA, USA (16 Nov 1987).

This paper discusses where the future of higher energy heavy ion acceleration may lead in terms of understanding the nucleus. The discussion concerns obstacles to formulating an equation of state for nuclear matter at high temperature and density. Implications of this research for astrophysical problems is also presented. (LSP)

23669 (UCID—21310) Cross sections and differential spectra for reactions of 2-20 MeV neutrons on /sup nat/Cr. Blann, M.; Komoto, T.T. (Lawrence Livermore National Lab., CA (USA)). Jan 1988. Contract W-7405-ENG-48. 33p. NTIS, PC A03. Order Number DE88006246/JAW.

This report summarizes product yields, secondary n,p and α spectra, and γ-ray spectra calculated for incident neutrons of 2 to 20 MeV on /sup nat/Cr targets. Results are all from the code ALICE, using the version ALISO which does weighting of results for targets which are a mix of isotopes. Where natural isotopic targets are involved, yields and n,p,α spectra will be reported weighted over isotopic yields. Gamma-ray spectra, however, will be reported for the most abundant isotope. We present product yields versus incident neutron energy, n,p,α spectra versus incident neutron energy, and calculated γ-ray spectra.

23670 Quark-gluon-plasma-dynamics and hadronization in high energy nuclear collisions. Heinz, U.; Lee, K.S.; Rhoades-Brown, M.J. (Regensburg Univ., Germany, F.R. Inst. fuer Physik 1 - Theoretische Physik; Brookhaven National Lab., Upton, NY, USA). *Verhandlungen der Deutschen Physikalischen Gesellschaft;* **23**: No. 6, B7.1(Mar 1988). (CONF-880347—).

From Spring meeting of the Fachausschuss Kern- und Mittelenergiephysik of the Deutsche Physikalische Gesellschaft e.V.; Berlin, F.R. Germany (21 Mar 1988).

23671 Polarization-asymmetry relations in neutron optics. Kabir, P.K. (Research Institute for Theoretical Physics, University of Helsinki, Helsinki, Finland). *Physical Review Letters;* **60**: No. 8, 686-687(22 Feb 1988).

Polarization-asymmetry theorems are established which provide unambiguous tests of time-reversal invariance.

23672 Possibility of optically induced nuclear fission. Boyer, K.; Luk, T.S.; Rhodes, C.K. (Laboratory for Atomic, Molecular and Radiation Physics, Department of Physics, University of Illinois at Chicago, P.O. Box 4348, Chicago, Illinois 60680). *Physical Review Letters;* **60**: No. 7, 557-560(15 Feb 1988).

The process of nuclear fission induced by nonlinear radiative coupling to atomic electrons is considered. For 248-nm radiation at an intensity of ≅10/sup 21/ W/cm², highly relativistic currents are produced which can couple to the fission mode of nuclear decay. With irradiation for a time of ≅100 fs the results indicate a fission probability of ≅10/sup -5/ for /sub //sub <2/ /sub 92//sup 38/U nuclei located at the surface of a solid target, a value several orders of magnitude above the limit of detection.

23673 New, simplified, interpolation method for estimation of microscopic nuclear masses based on the p-factor, P = N/sub P/N/sub N//(N/sub p/+N/sub n/). Haustein, P.E.; Brenner, D.S.; Casten, R.F. (Brookhaven National Laboratory, Upton, NY 11973 USA). *AIP (American Institute of Physics) Conference Proceedings;* **164**: No. 1, 84-88(10 Dec 1987). (CONF-870970—). Contract AC02-79ER10493;AC02-76CH00016.

From 5. international conference on nuclei far from stability; Lake Rosseau, Canada (14 Sep 1987).

A new semi-empirical method, based on the use of the P-factor (P = N/sub p/N/sub n//(N/sub p/+N/sub n/)), is shown to simplify significantly the systematics of atomic masses. Its uses is illustrated for actinide nuclei where complicated patterns of mass systematics seen in traditional plots versus Z, N, or isospin are consolidated and transformed into linear ones extending over long isotopic and isotonic sequences. The linearization of the systematics by this procedure provides a simple basis for mass prediction. For many unmeasured nuclei beyond the known mass surface, the P-factor method operates by interpolation among data for known nuclei rather than by extrapolation, as is common in other mass models.

23674 Nuclear shape coexistence and the study of nuclei far from stability. Wood, J.L. (School of Physics, Ga. Tech., Atlanta, Ga. 30332, USA). *AIP (American Institute of Physics) Conference Proceedings;* **164**: No. 1, 245-254(10 Dec 1987). (CONF-870970—).

From 5. international conference on nuclei far from stability; Lake Rosseau, Canada (14 Sep 1987).

The systematic features of shape coexistence are briefly outlined. The most useful spectroscopic fingerprints for identifying shape coexistence far from stability are presented. Directions for future work are discussed.

23675 Oblate-prolate shape competition in Z = 34—38 nuclei. Eberth, J.; Wiosna, M.; Mylaeus, T.; Schmal, N.; Skoda, S.; Busch, J.; Teichert, W.; Brentano, P.v.; Hamilton, J.H.; Ramayya, A.V.; and others. (University of Koeln, Koeln, W. Germany). *AIP (American Institute of Physics) Conference Proceedings;* **164**: No. 1, 268-277(10 Dec 1987). (CONF-870970—).

From 5. international conference on nuclei far from stability; Lake Rosseau, Canada (14 Sep 1987).

Now magic numbers for deformed shapes are established at N and Z of 38 and N of 60. These shell gaps at large deformation ($\beta \sim 0.4$) are magic when the proton and neutron shell gaps reinforce each other. Other shell gaps for 34 and 36 are predicted to be important for oblate deformation. The competition between these oblate and the 38 prolate gaps as well as the 40 spherical shell gap are considered. In ^{71}Se coexistence of oblate ($\beta \sim 0.24$) and large prolate ($\beta \sim 0.4$) shapes are observed. In ^{72}Se the excited prolate band with large deformation which coexists with the near-spherical ground state is found to dominate the yrast spectrum to 28^+. The moment of inertia of this band is essentially that of a rigid body. This moment of inertia supports the suggestion that the "super deformation", $\beta \sim 0.4$, being observed in this region may be associated with a collapse of pairing.

23676 Alternate interpretation of the results from the St. Gotthard laboratory double beta decay experiment. Avignone, F.T. III; Brodzinski, R.L.; Miley, H.S.; Reeves, J.H. (South Carolina Univ., Columbia (USA). Dept. of Physics and Astronomy; Battelle Pacific Northwest Labs., Richland, WA (USA)). *Physics Letters [Section] B;* **198**: No. 2, 253-254(19 Nov 1987). Contract AC06-76RL01830.

The data from the recent search for neutrinoless double beta decay with the emission of majorons in the St. Gotthard underground laboratory is reinterpreted. A model of the unknown background continuum, more consistent with auxiliary shielding experiments, results in a central value T/sub 1/2/ = 4.3 x 10/sup 20/ yr for this decay. All of the corrections in the original article are accepted at face value.

23677 Comment on "Dynamical symmetries of the interacting-boson model from a non-U(6) viewpoint". Ginocchio, J.N.; Casten, R.F.; Feng, D.H.; Wu, C.L.; Han, X.L. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review Letters;* **59**: No. 12, 1373-1373(21 Sep 1987).

A Comment on the Letter by H. B. Geyer, F. J. W. Hahne, and F. G. Scholtz, Phys. Rev. Lett. 58, 459 (1987).

23678 Medium-modified form factors, relativistic dynamics, and the (e,e'p) reaction. Cohen, T.D.; Van Orden, J.W.; Picklesimer, A. (Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). *Physical Review Letters;* **59**: No. 12, 1267-1269(21 Sep 1987).

We examine the effects of relativistic dynamics and medium-modified electromagnetic form factors on the ratio of transverse to longitudinal response in (e,e'p). Calculations performed in the distorted-wave impulse approximation show that the effects of Dirac dynamics and medium-modified form factors are small. We also show that current data seem consistent with our distorted-wave impulse approximation calculations.

23679 (JINR—D-3,4,17-86-747, pp 7-17) Problems of current status of statistical nuclear theory. Ignatyuk, A.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1987. (In Russian). NTIS (US Sales Only), PC A21/MF A01. Order Number DE88780064/JAW. (CONF-8610176—).

From 5. international school on neutron physics; Alushta, USSR (20 Oct 1986).

Current status of statistical nucleus theory, used for analysing a wide range of nuclear reactions, occuring through the compound nucleus stage, is considered. Excited residual nucleus level density and the cross section of absorption of the considered particle by the excited nucleus, or, as it is usually called, reverse reaction cross section appear to be the main components of such analysis. Questions, related to the errors of this cross section replacement by the cross section of particle absorption by the nucleus in the ground state and to construction of a renified coordinated description of level densities and the whole set of reverse reaction cross sections appear to be basically important. It is mentioned, that qualitative confirmations concerning the reverse reaction cross section difference from the cross section of absorption of particles by the

unexcited nucleus, are available. A conclusion is drawn, that theoretical approaches to describing the main statistical characteristics of the excited nuclei, coordinated with theoretical models, used for analysing rich spectroscopic material concerning the nucleus low-lying level properties, are currently available. 24 refs.; 6 figs.

23680 (JINR—D-3,4,17-86-747, pp 18-28) **Microscopic description of neutron and radiative strength functions.** Voronov, V.V.; Zhuravlev, I.P. 1987. (In Russian). NTIS (US Sales Only), PC A21/MF A01. Order Number DE88780064/JAW. (CONF-8610176—).

From 5. international school on neutron physics; Alushta, USSR (20 Oct 1986).

Some results of investigation into spherical nucleus neutron and radiative strength functions, obtained within the framework of a microscopic method, based on quasiparticle-phonon model (QPM), are discussed. Experimental and calculated data on neutron strength functions in /sup 117,119,121,123,125/Sn isotopes and photoabsorption integral cross sections in /sup 206,207,208/Pb, /sup 209/Bi, /sup 205/Tl nuclei are presented. The investigations conducted show, that microscopic methods both present sufficiently good description of experimental data for neutron and radiative strength functions and allow one to make predictions. 35 refs.; 2 figs.

23681 (JINR—D-3,4,17-86-747, pp 90-112) **Determination of nucleus properties on the base of neutron elastic scattering anisotropy.** Popov, A.B.; Samosvat, G.S. 1987. (In Russian). NTIS (US Sales Only), PC A21/MF A01. Order Number DE88780064/JAW. (CONF-8610176—).

From 5. international school on neutron physics; Alushta, USSR (20 Oct 1986).

A comparatively new trend in neutron spectrometry, namely, elastic scattering differential cross section spectrometry, is presented. Extraction of strength functions and phase shifts for S- and p-neutrons from the averaged differential cross sections, in fact appears to be a new method to obtain mean neutron parameters. By its results the new trend adds to μ completes the traditional neutron spectrometry. It also allows one to obtain data on those nucleus properties, which cannot be easily determined by other methods, namely, resonance orbital moments and spins, spin channel mixtures in p-resonances, scattering radii and neutron strength functions for P/sub 1/2/-and P/sub 3/2/-neutrons. 42 refs.; 12 figs.

23682 (JINR—D-3,4,17-86-747, pp 113-122) **P-parity angular correlations in the resonant (nγ) and (pγ) reactions.** Sharapov, Eh.N. 1987. (In Russian). NTIS (US Sales Only), PC A21/MF A01. Order Number DE88780064/JAW. (CONF-8610176—).

From 5. international school on neutron physics; Alushta, USSR (20 Oct 1986).

The main aim of the lecture is to present some results of studying p-parity angular correlations in (n, γ) reaction, which appears to be a new trend in p-wave neutron spectroscopy, initiated at the JINR Neutron Physics Laboratory. Values of spins J, full widths, partial radiation widths of direct transition neutron widths γ/sub s//sup 2/ of the channel with the spin S=1 as well as γ/sub 1/2/, γ/sub 3/2/ amplitude relative sign in j-representation, are determined for low-energy p-resonances in the described neutron experiments with tin-117, cadmium-111, cadmium-113 targets, p-parity effects in (p, γ) reactions are also mentioned. 23 refs.; 11 figs.

23683 (JINR—D-3,4,17-86-747, pp 123-133) **Parity and time reversal violation in nuclei.** Adelberger, E.G. (Washington Univ., Seattle, USA. Nuclear Physics Lab.; Washington Univ., Seattle, USA. Dept. of Physics). 1987. NTIS (US Sales Only), PC A21/MF A01. Order Number DE88780064/JAW. (CONF-8610176—).

From 5. international school on neutron physics; Alushta, USSR (20 Oct 1986).

The current status of investigations into parity (P) and time-reversal (T) violation in nuclei is considered. Nuclear P-violation is an expected consequence of the standard model. It has been observed in a wide variety of nuclei (from A=2, to A~ 200) by using a wide variety of reactions (reactions induced by polarized neutrons and polarized protons, γ-decay, α-decay, and (α, γ) reactions). 22 refs.; 7 figs.

23684 (JINR—D-3,4,17-86-747, pp 134-152) **Some aspects of nucleus fission.** Ostapenko, Yu.B.; Smirenkin, G.N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1987. (In Russian). NTIS (US Sales Only), PC A21/MF A01. Order Number DE88780064/JAW. (CONF-8610176—).

From 5. international school on neutron physics; Alushta, USSR (20 Oct 1986).

Problems of "thorium anomaly" and fission barrier "valley" structure are considered within the framework of Strutinsky shell correction method. Both of them are linked with much later and less studied stages of fission process, when the nucleus mass-asymmetry deformations sufficiently effect the observed fission properties. They are manifested in the probability of the fragments passage through the barrier and their distribution in space (for the first problem), as well as in mass-energy distribution of fragments (for the second one). 49 refs.; 12 figs.

23685 **Bose-fermi symmetries and SUSY in nuclei.** Casten, R.F. (Brookhaven National Lab., Upton, Long Island, NY). pp 168-174 of Nuclear structure, reactions and symmetries. Meyer, R.A.; Paar, V. Teaneck, NJ; World Scientific Pub. Co. (1986). (CONF-8606130—).

From International conference on nuclear structure, reactions, and symmetries; Dubrovnik, Yugoslavia (5 Jun 1986).

Most of the comparison with theory has compared energy levels and we have seen many beautiful examples of one-to-one level correspondences, sometimes supported with a few B(E2) values. However, what we really need to check, the author thinks, is the structural correspondence, to make sure these levels really correspond to each other, and that the energy level agreement is not just accidental; for that we need to look at transfer reactions, and more B(E2)'s. This brings up the very important question of the transfer operator. The author hopes that its importance can be seen in recent cases where a few B(E2)'s for a few transfer strengths have substantially changed the correspondence between theoretical and experimental levels even though the overall energy level agreement is neither better or worse. So it's clearly sensitive to that question. Also cases have been seen now where several different supergroups have been applied to the same regions, U(6/4) and U(6/20) for example, to the mass 130 region, and so the question of the single-particle spaces and the single-particle energies is an important one. The question of microscopic understanding of the parameters and the interactions, these bose-fermi symmetries is important since it probes the underlying physical basis. And finally there have be some very interesting, what the author calls "exotic" extensions of bose-fermi symmetry ideas presented at this meeting. One is the extension to odd-odd nuclei, another is the generalized SUSY extension that can apply to transition regions, and this is the interesting beta decay calculations of Dobes that were reported yesterday, and probably some others the author has missed.

6540 Radiation And Shielding Physics

REFER ALSO TO CITATION(S) 22296, 23978, 24043

23686 **(CEA-R—5407) Benchmark solutions in radiation transfer.** Munier, A. (CEA Centre d'Etudes de Limeil, 94 - Villeneuve-Saint-Georges (France)). Aug 1987. 35p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752109/JAW.

Some simple analytical solutions are given to the radiation transfer equation in a homogeneous, static collisionless medium. We examine the propagation in a slab, then the passage through and the contact between two plates and finally the transfer in a sphere.

23687 **(CNIC—00044) Comparison between finite difference solution of neutron transport equation and corresponding exact solution.** Du Xiangwan; Wu Dezhang; Yang Guoguang; Wang Yuanzhang. (China Nuclear Information Centre, Beijing, BJ). 1987. 11p. (In Chinese). (IAPCM—0001). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700955/JAW.

The error analysis of finite-difference method in computing critical size and neutron flux is given. The exact solution in non

critical case has been extrapolated from the exact solution in critical case. The exact solutions are compared with corresponding solutions obtained by finite-difference method. The influences of the computational scheme and the region step on the results have been examined. Error sources and associated regularities are discussed as well.

23688 **(CNIC—00045) Theoretical research for the properties of neutron absorber /sup 6/LiH and B(CH/sub 2/)/sub x/.** Liu Gongliang. (China Nuclear Information Centre, Beijing, BJ). 1987. 9p. (In Chinese). (IAPCM—0002). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700956/JAW.

In this paper, several features of neutronics for /sup 6/LiH and B(CH/sub 2/)/sub chi/ are calculated by using slowing-down theory and Monte Carlo method. In terms of resonance escape probability P, average slowing-down time T and average slowing-down length L/sub s/, we introduce a new quantity <L/sub s//sup 2/T>chemical bond/sub P=/P/sub 0/ which describes reasonably the properties of neutron absorber. A comparison is made for two absorbers. We have found a optimal element ratio for Boron-polyethylene absorber.

23689 **(CNIC—00046) Multigroup approximation and the numerical algorithm for the contribution transport equation.** Du Shuhua. (China Nuclear Information Centre, Beijing, BJ). 1987. 10p. (In Chinese). (IAPCM—0003). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700957/JAW.

This paper begins with discussion on the solution of the energy dependent equation for the neutron importance by using the Fourier transform and on the sulution of the contribution transport equation in plane geometry by using the finite Fourier transform. Based on the above solution, the methods to determine the multigroup constants for the contribution equation are investigated. Numerical difference schemes are given for solving the multigroup contribution transport equation, and related calculational procedure and algorithms are also proposed.

23690 **(CNIC—00047) Multigroup flux-limited asymptotic diffusion Fokker-Planck equation.** Liu Chengan. (China Nuclear Information Centre, Beijing, BJ). 1987. 11p. (In Chinese). (IAPCM—0004). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700958/JAW.

A more perfrect flux-limited method is applied to combine with asymptotic diffusion theory of the radiation transpore, and the high peaked component in the scattering angle is treated with Fokker-Planck methods, thus the flux-limited asymptotic diffusion Fokker-Planck equation has been founded. Since the equation is of diffusion form, it retains the simplity and the convenience of the classical diffusion theory, and improves precision in describing radiation transport problems.

23691 **(EFI—928(79)-86) Fluctuations and probable values of ionization energy losses for high-energy heavy ions in thin gas layers.** Margaryan, A.T. (Erevanskij Fizicheskij Inst. (USSR)). 1986. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701551/JAW.

The reasons of discrepancy between theory and results of measurement of ionization fluctuations and values of probable ionization for high-energy heavy ions in thin gas layers are analyzed. The Monte-Carlo calculations are presented with account of electron transfer under real experimetal conditions, fluctuations and probable values of ionization energy losses in the gas mixture (Ar (93%) + CH/sub 4/ (7%)) by /sup 3/He, /sup 12/C, /sup 20/Ne, /sup 40/Ar and /sup 56/Fe ions. The calculation results agree with the experimental data to the accuracy of <or approx. 3%. 16 refs.; 4 figs.

23692 **(ENEA-RT-TIB—84-35) Elementary interaction matrix elements for FP/sub ∞//sup N/-B/sub N/ generalized Fourier transform method in anisotropic neutron transport.** Chiccoli, C.; Premuda, F. (Istituto Nazionale di Fisica Nucleare, Bologna (Italy); ENEA, Bologna (Italy). Dip. Tecnologie Intersettoriali). (ENEA, Rome (Italy)). 1985. 103p. NTIS (US Sales Only), PC A06/MF A01. Order Number TI88701728/JAW.

Exhaustive treatment is presented for the analytical and numerical evaluation of elementary spatial and angular interaction matrix elements arising in transport problems with anisotropic scattering when plane and spherical geometries in order. Their use concern mainly projected FP/sub ∞//sup N/-B/sub N/ Fourier generalized transform method adopted to face anisotropic scattering neutron transport in spectral calculation for fast reactors and in multilayer plane systems for shielding problems. Their application extend to radioactive transfer and to high energy charged particles sputtering problems. 41 refs.

23693 **(FEI—1786) Method of production and foundation of Monte Carlo evaluations for flux surface potentials in the problems of radiation transport.** Blyskavka, A.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1986. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701011/JAW.

On the basis of representing a surface integral of the flux as an integral along a certain volume, and using evaluations of ranges for the latter one a family of Monte Carlo evaluations for surface functionals in the radiation transport theory is obtained. Evaluations are examplified, among which earlier unknown are present. 2 refs.

23694 **(IFUSP-P—651) Uniform semiclassical approximation for absorptive scattering systems.** Hussein, M.S.; Pato, M.P. (Sao Paulo Univ. (Brazil). Inst. de Fisica). Jul 1987. 13p. NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701583/JAW.

The uniform semiclassical approximation of the elastic scattering amplitude is generalized to absorptive systems. An integral equation is derived which connects the absorption modified amplitude to the absorption free one. Division of the amplitude into a diffractive and refractive components is then made possible.

23695 **(INIS-BR—951) Theorems of low energy in Compton scattering.** Chahine, J. (Sao Paulo Univ., Sao Carlos, SP (Brazil). Inst. de Fisica e Quimica). 1984. 59p. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number TI88701605/JAW.

We have obtained the low energy theorems in Compton scattering to third and fouth order in the frequency of the incident photon. Next we calculated the polarized cross section to third order and the unpolarized to fourth order in terms of partial amplitudes not covered by the low energy theorems, what will permit the experimental determination of these partial amplitudes.

23696 **(ITEF—49(1986)) Comparison of calculations of neutron transport with the base integral experiments.** Achkasov, S.K.; Kochevalin, Yu.V.; Lukhminskij, B.E.; Lyutostanskij, Yu.S.; Lyashuk, V.I.; Panov, I.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1986. 26p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701115/JAW.

The results of calculations of neutron radiation and transmission spectra performed according to the MAMONT program are compared with experimental data obtained in base experiments as well as with calculated data by the ROZ and ANISN programs for these experiments. Correspondence between MAMONT results and experimental data is not worse and sometimes better than that obtained by these programs. 11 refs.; 8 figs.; 9 tabs.

23697 **(JINR-R—3-87-326) Ultracold neutron diffusion in magnetic neutron guides and powders.** Ignatovich, V.K.; Nikitenko, Yu.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1987. 15p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701663/JAW.

Submitted to the journal Zh. Ehksp. Teor. Fiz. .

The solution of the problem of ultracold neutron diffusion in magnetic neutron guides and powders, obtained with the help of recursion relations for neutron density is given. 3 refs.; 3 figs.

23698 **(JINR-R—4-87-402) Diffusion of ultracold neutrons in neutron guides in the presence of gravitational field.** Ignatovich, V.K. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1987. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701666/JAW.

Submitted to the journal Zh. Ehksp. Teor. Fiz. .

New expression for particle diffusion flux in the presence of an external field is introduced. It goes over into the usual one in the case of thermal equilibrium. Diffusion equation and its solution are found. The ultracold neutron transmission through vertical and inclined neutron guide is obtained. 3 refs.; 1 fig.

23699 **(KIYI—86-27) Interaction of slow neutrons with ^{74}Ge single crystals.** Pshenichnyj, V.A.; Pak En Men; Vorobkalo, F.M.; Vertebnyj, V.P. (AN Ukrainskoj SSR, Kiev. Inst. Yadernykh Issledovanij). 1986. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703010/JAW.

The total cross section of monocrystal from germanium-74 isotope by the time-of-flight method in the 0.017-10 eV range is measured. At room temperatures the above monocrystal possesses the capability of separating from the white reactor spectrum intensive beams of thermal neutrons. It is shown that the ^{74}Ge monocrystal by its filtering properties approaches to the Si monocrystal. The observed cross sections for Si, Ge, ^{74}Ge monocrystals in the thermal region of neutron energy are indicated in the study. 6 references, 1 figure, 1 table.

23700 **Application of the closure relation in transport theory.** Paveri-Fontana, S.L.; Zweifel, P.F. (Dipartimento di Metodi e Modelli Matematici, Universita di Roma "La Sapienza", Via Scarpa 10, 00161 Roma, Italy). *Transport Theory and Statistical Physics;* **16**: No. 8, 1095-1127(Dec 1987).

The closure method for proving completeness of Case eigenfunctions is reviewed, and seems to have a number of advantages. A major advantage is the ease with which embedded eigenvalues can be treated. This is illustrated with an example from azimuthally asymmetric transport theory.

23701 (JINR—D-3,4,17-86-747, pp 192-210) **Neutron microscopy: first results and perspectives.** Frank, A.I. (Gor'kovskij Gosudarstvennyj Univ., USSR). 1987. (In Russian). NTIS (US Sales Only), PC A21/MF A01. Order Number DE88780064/JAW. (CONF-8610176—).

From 5. international school on neutron physics; Alushta, USSR (20 Oct 1986).

Problems of neutron microscopy using very slow neutrons (VSN) are discussed. This term implies ultracold neutrons (UCN), which have undergone a complete reflection from a substance and possess rates of the order of 10 m/s and lower, and very cold neutrons (VCN) with their rates being up to about 100 m/s. The authors use the term "UCN" without making any difference between UCN and VCN. Formation of image in neutron waves, optical elements for a neutron microscope (NM), UCN optics in the gravitational field, UCN sources for NM are considered. Possible areas of NM application are proposed. 43 refs.; 7 figs.

23702 (JINR—D-3,4,17-86-747, pp 259-272) **Neutron scattering in glasses.** Plakida, N.M. 1987. (In Russian). NTIS (US Sales Only), PC A21/MF A01. Order Number DE88780064/JAW. (CONF-8610176—).

From 5. international school on neutron physics; Alushta, USSR (20 Oct 1986).

Basic provision of theory concerning neutron scattering in glasses are considered. Apart from structural investigations, experiments on neutron inelastic scattering are discussed in which apart from scattering on long-wave excitations of acoustic type - phonons, additional inelastic scattering in the low energy area, conditioned by quasilocal type excitations, was observed. Application of neutron scattering in glasses allows one to obtai unique microscopic data on the structure and dynamics of disordered systems, inaccessible for other methods. 14 refs.

23703 **Mechanisms for free electron production in energy loss by charged particles in gaseous targets.** DuBois, R.D.; Toburen, L.H. (Pacific Northwest Lab., Richland, WA 99352). pp 50 of Thirty-fifth annual meeting of the Radiation Research Society (Abstracts). Philadelphia, PA; Radiation Research Society (1987). (CONF-870221—). Contract AC06-76RL01830.

From 35. annual meeting of the Radiation Research Society; Atlanta, GA, USA (22 Feb 1987).

Ions transversing matter primarily lose energy via ionizing collisions. Although detailed information about the energy loss in the collisions can be obtained by studying the emitted electron spectra, no information about the final state of the target is obtained. In order to provide this information, the authors measured the individual cross sections for the various target charge states which occur as a result of direct ionization, electron capture by the projectile, and (in the case of He/sup +/ impact) electron loss by the projectile. These measurements were performed over a broad range of impact energies for H/sup +/, He/sup +/ and He/sup 2+/ impact on rare gases and are currently in progress for H/sup o/ and He/sup o/ impact. Thus a complete picture of energy loss by fast H/sup +/ and He/sup 2+/ ions slowing down in gaseous media is obtained. The authors found that multiple ionization processes are extremely important processes and sometimes are the primary sources of free electrons.

23704 **Multiple Coulomb scattering of high-energy heavy charged particle beams used in biology and medicine.** Wong, M.; Schimmerling, W.; Ludewigt, B.; Phillips, M.; Curtis, S.; Tobias, C.A. (Univ. of California, Lawrence Berkeley Lab., Berkeley, CA 94720). pp 49 of Thirty-fifth annual meeting of the Radiation Research Society (Abstracts). Philadelphia, PA; Radiation Research Society (1987). (CONF-870221—).

From 35. annual meeting of the Radiation Research Society; Atlanta, GA, USA (22 Feb 1987).

The authors measured lateral displacement and angular distributions of high-energy heavy charged particles emerging from a target at the Lawrence Berkeley Laboratory BEVALAC with beams used in radiobiology experiments. Multiple Coulomb scattering occurring in the target material generally spreads the beam laterally and increases its divergence. The apparatus consists of four sets of position-sensitive semiconductor detectors located along the beam line. Each providing two position signals and one energy signal. The difference between the two position signals is used to determine the particle position in one dimension. The two position signals are constrained to add up to the energy deposition signal in order to reject multiple-particle traversals. The vector directions for the incident and emerging particles are reconstructed in three dimensions from their measured coordinated positions. Lateral and angular distributions are reported for beams of high-energy neon, iron and uranium ions incident on targets of aluminum, cooper, lead and water.

6550 Medical Physics

REFER ALSO TO CITATION(S) 21968, 22413, 22519, 22921, 22924, 23074, 23089, 23091, 23092, 23589, 23886, 23887

23705 **(CEA-R—5398) Catalogue of neutron spectra.** Buxerolle, M.; Massoutie, M.; Kurdjian, J. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France)). Sep 1987. 66p. (In French). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88752145/JAW.

Neutron dosimetry problems have arisen as a result of developments in the applications of nuclear energy. The largest number of possible irradiation situations has been collected: they are presented in the form of a compilation of 44 neutron spectra. Diagrams show the variations of energy fluence and energy fluence weighted by the dose equivalent/fluence conversion factor, with the logarithm of the corresponding energy. The equivalent dose distributions are presented as percentages for the following energy bins: 0.01 eV/0.5 eV/50 keV/1 MeV/5 MeV/15 MeV. The dose equivalent, the mean energy and the effective energy for the dose equivalent for 1 neutron cm/sup -2/ are also given.

23706 **(ENEA-RT-PAS—85-10) Mercure IV code application to the external dose computation from low and medium level wastes.** Tomassini, T. (ENEA, Rome (Italy)). 1985. 47p. (In Italian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700989/JAW.

In the present work the external dose from low and medium level wastes is calculated using MERCURE IV code. The code utilizes MONTECARLO method for integrating multigroup line of sight attenuation Kernels.

23707 **(ENEA-RT-PAS—87-12) Analysis in cytokinesis-blocked human lymphocytes. A new approach to the biological dosimetry.** Catena, C.; Mattoni, A. (ENEA, Casaccia (Italy). Centro Ricerche Energia). (ENEA, Rome (Italy)). 1987. 51p. (In Italian). NTIS (US Sales Only), PC A04/MF A01. Order Number TI88701560/JAW.

Biological dosimetry can be considered as an additional method to physical dosimetry for estimating dose absorption after exposure to ionizing radiation. Fully validated as well as new promising approaches in this field are reviewed. Recent experiments, carried out in our laboratory, on the analysis of micronuclei in cytokinesis-blocked human lymphocytes are presented. The possible relevance of differential human individual response to ionizing radiation, in view of the occurrence of radiosensitive syndromes, for the estimation of the absorbed dose in human is also discussed. 83 refs.

23708 (INIS-BR—585, pp 187) **Study of equivalent dose, time integrated, in a big hospital.** Almeida, A. de; Paula, E. de; Ghilardi Netto, T. 1985. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780098/JAW. (CONF-8509378—).

From 20. Brazilian Congress of Radiology; 4. Brazilian Congress of Ultrasonography; 2. Latin American Congress of Ultrasonography; 1. Brazilian Congress of Physicists in Medicine; Belo Horizonte, Brazil (15 Sep 1985).

23709 **(INIS-BR—924) Dose measurement for X-ray diagnostic workers.** Briquet, C.; Araujo, A.M.C. de. (Sociedade Brasileira de Radiologia, Sao Paulo). 1986. 1p. (In Portuguese). (CONF-8611223—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701465/JAW.

From 18. meeting on radiology from Rio de Janeiro; 10. meeting on radiology residents from Rio de Janeiro; Rio de Janeiro, Brazil (19 Nov 1986).

23710 (INIS-mf—10846, pp 75) **Model for estimating the concentration of Ra-226 in the human body and calculation of doses.** Forgo, Cs.; Mures, T. Nov 1984. NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

23711 (INIS-mf—10846, pp 76) **Topgraphycal and anatomical unification of man phantom for computer calculations and dosimetrical experimants.** Golikov, V.; Nikitin, V.; Ermakov, I.; Masarski, L.; Saltykova, L. (Nauchno-Issledovatel'skij Institute Radiatsionnoj Gigieny, Leningrad, USSR; Tsentral'nyj Nauchno-Issledovatel'skij Rentgeno-Radiologicheskij Institute, Leningrad, USSR). Nov 1984. NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

23712 (INIS-mf—10846, pp 80) **Measurement of absorbed dose at the interface between two different media using thermoluminescent dosemeters. Applications in radiation medicine and radiobiology.** Milu, C. (Clinical Hospital Fundeni, Bucharest, Romania). Nov 1984. NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

23713 (INIS-mf—10846, pp 82) **Recomendations for clinical dosimetry of photon and electron beams.** Novotny, J. (Ceskoslovenska Akademie Ved, Prague). Nov 1984. NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

23714 (INIS-mf—10846, pp 85) **Radiation quantity and quality calculations for pulsating potential X-ray generators.** Porubszki, T. (Medicor Muevek, Budapest, Hungary). Nov 1984. NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

23715 (INIS-mf—10846, pp 54) **Dose distribution in water phantom for gamma-therapy unit ROCUS.** Penchev, V.; Konstantinov, B.; Ivanova, K. (Meditsinska Akademiya, Sofia, Bulgaria). Nov 1984. (In Bulgarian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

23716 (INIS-mf—10846, pp 63) **Metrological control of radionuclide calibrators on ionization chambers used in nuclear medicine.** Sereni, A.; Vagweldi, J. Nov 1984. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW. (CONF-8411296—Absts.).

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

23717 **(IRD-CNEN-NT—014/87) Individual neutron dosimetry.** Mauricio, C.L.P. (Instituto de Radioprotecao e Dosimetria, Rio de Janeiro (Brazil)). 1987. 49p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number TI88701635/JAW.

The most important concepts and development in individual neutron dosimetry are presented, especially the dosimetric properties of the albedo technique. The main problem in albedo dosimetry is to calibrate the dosemeter in the environs of each neutron source. Some of the most used calibration techniques are discussed. The IRD albedo dosemeter used in the routine neutron individual monitoring is described in detail. Its dosimetric properties and calibration methods are discussed.

23718 **(PINSTECH/HPD—115) Revised radiation emergency procedures at Pakistan research reactor PINSTECH.** Orfi, S.D.; Javed, M.; Ahmad, S.; Akhtar, K.M.; Mubarak, M.A. (Pakistan Inst. of Nuclear Science and Technology, Rawalpindi. Health Physics Div.). Dec 1984. 26p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701217/JAW.

Necessary procedures have been laid down in this report to meet the radiation emergency at Pakistan Research Reactor PIN-

STECH. The Nuclear Safety Committee PINSTECH (NSCP) had also recommended a number of improvements in the existing procedures. Revision of the procedures was also considered necessary to incorporate into it new radiation units/limits and new emergency equipment available. Radiation emergency preparedness programme is of continuous nature. Latest developments else-where and local experience contribute to the improvement of the existing arrangements under this programme. (A.B.).

23719 **(RCNP-P—82) Radiation control in accelerator facilities. Workshop for the next project in the Research Center for Nuclear Physics, Osaka University.** (Osaka Univ., Ibaraki (Japan). Research Center for Nuclear Physics). May 1986. 73p. (In Japanese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE87703018/JAW.

In view of radiation control, particle accelerator facilities have posed various problems involving radiation (mainly neutron) leakage, occupational exposure, environmental aspects in the surrounding area, and waste management. The intent of the workshop was to discuss these problems. This report contains nine topics that were presented and discussed: (1) Radiation safety system for the AVF cyclotron and the cyclotron cascade project at the Research Center for Nuclear Physics, Osaka University; (2) Calculation for the shielding design in the RIKEN Ring Cyclotron Facility; (3) Shielding design method for high-energy protons in the National Laboratory for High-energy Physics (KEK); (4) Radiation safety programme for the uses of medical accelerators in the National Institute of Radiological Sciences; (5) Development of the new stack air monitor; (6) Environmental radiation monitoring in the vicinity of the intense 14 Mev neutron source facility; (7) Radiation control around the KEK-proton synchroton; (8) Radiation safety control system for the RIKEN Ring Cyclotron; (9) Evaluation of radioactivity and skyshine induced by neutron production in an accelerator facility.

23720 **(VROM-DSB—87-26) Dose conversion factors, reduction factors and criteria of injuries for radioactive materials.** Jong, P. de. (Hoofdgroep Maatschappelijke Technologie TNO (Malta), Apeldoorn (Netherlands)). (Ministerie van Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer, The Hague (Netherlands). Directie Stralenbescherming). Apr 1987. 35p. (In Dutch). (VROM—70289/4-87). NTIS (US Sales Only), PC A03/MF A01. Order Number TI88701778/JAW.

In the framework of the project 'Information- and calculation-system for disaster combatment' of the Dutch Institute for Technical Physical Research (TNO), a subinvestigation is devoted to conversion factors, reduction factors and criteria of injuries caused by radioactive materials. This report gives a survey of the procedure followed and the results derived for dose- and effect-calculation for ionizing radiation caused by external irradiation from the cloud, from the ground and internal irradiation by inhalation. Also a survey is given of the relations to be handled for shielding by staying in buildings and forms of injuries to persons. 24 refs.; 2 figs.; 8 tabs.

23721 **VUV-soft x-ray beamline for spectroscopy and calibration.** Bartlett, R.J.; Trela, W.J.; Michaud, F.D.; Southworth, S.H.; Rothe, R.; Alkire, R.W. (Los Alamos National Lab., P.O. Box 1663, Mail Stop D410, Los Alamos, NM 87545). pp 200-207 of X-ray calibration: Techniques, sources and detectors. Rockett, P.D.; Lee, P. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1986). (CONF-860880—).

From 30. SPIE technical symposium on optics and optoelectronic engineering; San Diego, CA, USA (17 Aug 1986).

The authors describe the design and performance of the Los Alamos VUV synchrotron radiation beamline, U3C, on the VUV ring of the National Synchrotron Light Source at Brookhaven National Laboratory. The beamline uses separate function optics to collect and focus the horizontally and vertically diverging beam. The monochromator is a grazing incidence Roland circle instrument of the extended grasshopper design (ERG). A post monochromator refocusing mirror is used to focus or collimate the diverging beam from the monochromator. The beamline control and diagnostics systems are also discussed.

23722 **Synchrotron radiation beam lines as x-ray calibration sources.** Kirkland, J.P.; Neiser, R.A.; Elam, W.T.; Rife, J.C.; Hunter, W.R. (Sachs/Freeman Associates, Inc., 1401 McCormick Drive, Landover, MD 20785). pp 188-198 of X-ray calibration: Techniques, sources and detectors. Rockett, P.D.; Lee, P. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1986). (CONF-860880—).

From 30. SPIE technical symposium on optics and optoelectronic engineering; San Diego, CA, USA (17 Aug 1986).

Many beam lines have become available at storage rings and synchrotrons around the world, presenting the opportunity to use them as calibration sources in the VUV, soft and hard X-ray regions. Synchrotron radiation is unique in offering a high intensity, highly polarized, continuous spectrum in a single source. Other important characteristics such as high brightness, narrow or broad spectral width, degree of polarization, and spectral purity depend on a beam line's optics. A typical beam line at the National Synchrotron Light Source (NSLS) at Brookhaven National Laboratory will have photon fluxes of approximately 10/sup 11/ photons/sec with resolution ($\Delta e/e$) of greater than 7x10/sup -4/ into areas of 1 to 30 mm/sup 2/. The characterization of these sources and their use for calibration of diverse x-ray instrumentation are discussed. Illustrative data for PIN and photoelectron x-ray detectors is given.

23723 **A slitless, intensified readout, gated spectrometer wavelength and efficiency calibration, time response characterization.** Gerassimenko, M.; Fowler, M.C. (Univ. of California, Lawrence Livermore National Lab., Mail Stop 43, P.O. Box 808, Livermore, CA 94550). pp 61-68 of X-ray calibration: Techniques, sources and detectors. Rockett, P.D.; Lee, P. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1986). (CONF-860880—). Contract W-7405-ENG-48.

From 30. SPIE technical symposium on optics and optoelectronic engineering; San Diego, CA, USA (17 Aug 1986).

A spectrometer has been developed specifically for the x-ray laser effort at Lawrence Livermore National Laboratory (LLNL). The instrument takes advantage of the small divergence and size of the lasing source by positioning all three components - the source, a custom-ruled grating, and a microchannel plate (MCP) detector - on the Rowland circle. The sum of incident and diffracted angles is kept constant. Illuminating a pinhole at the source location with a z-pinch produces wavelength calibration at several energy ranges in the 65- to 200-eV interval. The same source used in conjunction with the MCP camera and Kodak 101 film yields the absolute detector efficiency. Ion bombardment of a beryllium target at the source location produces the x-rays necessary to determine the absolute efficiency of the grating-detector combination at 107 eV. Grating efficiency is then deduced from the MCP efficiency at that energy. Three 25-Ω stripline structures on the MCP allow sub-nanosecond gating of the spectrometer, which improves the signal-to-background ratio. The rise time response of the entire MCP detector-cable assembly is about 200 ps. The authors also measured the transmission of the filters that are used in suppressing ultraviolet backgrounds.

23724 **A high intensity line source for x-ray spectrometer calibration.** Thoe, R.S. (Univ. of California, Lawrence Livermore National Lab., Mail Stop 43, P.O. Box 808, Livermore, CA 94550). pp 11-18 of X-ray calibration: Techniques, sources and detectors. Rockett, P.D.; Lee, P. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1986). (CONF-860880—). Contract W-7405-ENG-48.

From 30. SPIE technical symposium on optics and optoelectronic engineering; San Diego, CA, USA (17 Aug 1986).

A high intensity electron-impact x-ray source using a one-dimensional Pierce lens has been built for the purpose of calibrating a bent crystal x-ray spectrometer. This source focuses up to 100 mA of 20-keV electrons to a line on a liquid-cooled anode. The line (which can serve as a virtual slit for the spectrometer) measures approximately 800 μ x 2 cm. The source is portable and therefore adaptable to numerous types of spectrometer applications. One particular application, the calibration of a high resolution (r = 10/sup 4/) time-resolved crystal spectrometer, is discussed in detail.

23725 Wolter x-ray microscope calibration. Gerassimenko, M. (Univ. of California, Lawrence Livermore National Lab., Mail Stop 43, P.O. Box 808, Livermore, CA 94550). pp 82-86 of X-ray calibration: Techniques, sources and detectors. Rockett, P.D.; Lee, P. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1986). (CONF-860880—). Contract W-7405-ENG-48.

From 30. SPIE technical symposium on optics and optoelectronic engineering; San Diego, CA, USA (17 Aug 1986).

A 22 x Wolter microscope was calibrated after several months of operation in the Lawrence Livermore National Laboratory (LLNL) Inertial Confinement Fusion program. Placing a point x-ray source at the microscope focus, I recorded the image plane spectrum, as well as the direct spectrum, and from the ratio of these two spectra derived an accurate estimate of the microscope solid angle in the 1-4 keV range. The solid angle was also calculated using the microscope geometry and composition. Comparison of this calculated value with the solid angle that was actually measured suggests contamination of the microscope surface.

23726 Crystal R/sub c/ calibrations with an uncollimated, point x-ray source. Rockett, P.D.; Bird, C.R.; Hailey, C.J.; Koenig, Z.; Lupton, J.; Geddes, J. (KMS Fusion, Inc., Ann Arbor, MI 48106). pp 114-120 of X-ray calibration: Techniques, sources and detectors. Rockett, P.D.; Lee, P. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1986). (CONF-860880—).

From 30. SPIE technical symposium on optics and optoelectronic engineering; San Diego, CA, USA (17 Aug 1986).

The calibration of crystal integrated reflectivity can be faithfully performed with an uncollimated, well-filtered point x-ray source. In this geometry the angle of illumination of the crystal greatly exceeds the crystal rocking angle. The crystal essentially collimates the scattered beam, establishing the detector acceptance angle. The authors measured single crystal R/sub c/'s in this way for a variety of crystals including PET, Beryl, LiF (200), several synthetic multilayers, silicon (111), and KAP. In addition they report the first measured R/sub c/ for convex curved metal multilayer crystals.

23727 Soft x-ray calibration of diffracting materials. Burkhalter, P.G.; Gilfrich, J.V.; Brown, D.B.; Rosen, D.L. (Naval Research Lab., Code 4680, Washington, DC 20375-5000). pp 121-127 of X-ray calibration: Techniques, sources and detectors. Rockett, P.D.; Lee, P. Bellingham, WA; Society of Photo-Optical Instrumentation Engineers (1986). (CONF-860880—).

From 30. SPIE technical symposium on optics and optoelectronic engineering; San Diego, CA, USA (17 Aug 1986).

X-ray spectral analysis plays a major role as a diagnostic for hot, dense plasmas. Various diffraction media are utilized as flat or convex-curved surfaces for collecting soft x-ray spectral data in the 200 eV - 2 keV energy range. Calibration of the diffracting surface provides means for absolute line emission measurements from plasma generating sources i.e., pulsed-discharge gas puff and focused laser-target interaction experiments. The purpose of this work is the evaluation and absolute intensity calibration of diffraction surfaces consisting of grown crystals (acid phthalate), naturally occurring crystals (beryl) and surfaces formed by vacuum deposition (multilayered structures).

23728 Facilities and techniques for x-ray diagnostic calibration in the 100-eV to 100-keV energy range. Gaines, J.L.; Wittmayer, F.J. (Univ. of California, Lawrence Livermore National Lab., Mail Stop 379, P.O. Box 808, Livermore, CA 94550). pp 155-166 of X-ray calibration: Techniques, sources and detectors. Rockett, P.D.; Lee, P. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1986). (CONF-860880—). Contract W-7405-ENG-48.

From 30. SPIE technical symposium on optics and optoelectronic engineering; San Diego, CA, USA (17 Aug 1986).

The Lawrence Livermore National Laboratory (LLNL) has been a pioneer in the field of x-ray diagnostic calibration for more than 20 years. The authors built steady state x-ray sources capable of supplying fluorescent lines of high spectral purity in the 100-eV to 100-keV energy range, and these sources have been used in the calibration of x-ray detectors, mirrors, crystals, filters, and film. This paper discusses their calibration philosophy and techniques, and describes some of the x-ray sources. Examples of actual calibration data are presented as well.

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REFER ALSO TO CITATION(S) 21973, 21982, 22002, 22076, 22093, 22132, 22146, 22298, 23630, 23786, 23895, 23981

23729 (AD-A—187369/4/XAB) Surface spin reorientation in thin Gd films on Fe in an applied magnetic field. Camley, R.E. (Colorado Univ., Colorado Springs (USA). Dept. of Physics and Energy Science). 1 Mar 1987. 5p. NTIS, PC A02/MF A01.

Pub. in Physical Review B, Vol. 35, No. 7, 3608-3611(1 Mar 1987).

The author investigated the magnetic system of a few layers of Gd on bulk Fe in the presence of a magnetic field using mean field theory and a simple model. At moderate temperatures and low fields, the system is in an aligned state where all the Fe spins point along the field direction and, because of the antiferromagnetic coupling of the Fe spins to the Gd spins, all the Gd spins are antiparallel to the field. For higher fields there is a phase transition to a twisted spin state where the Fe and Gd spins near the interface are at an angle with respect to the applied field.

23730 (AD-A—187445/2/XAB) Electron-phonon interaction and cyclotron resonance in two-dimensional electron gas. Horovitz, B.; Madhukar, A. (University of Southern California, Los Angeles (USA)). 1979. 4p. NTIS, PC A02/MF A01.

Pub. in Solid State Communications, Vol. 32, No. 8, 695-698(1979).

Results for the influence of electron-phonon interaction on the cyclotron effective mass and the resonance linewidth in a two-dimensional electron gas are presented. The temperature and magnetic field dependence is studied, and the existence of quantum oscillations is demonstrated. It is shown that the relevant phonon frequency in typical MOS inversion layers is very small so that the magneto-transport properties are temperature-dependent even at a few degrees Kelvin. Results are consistent with the observed temperature, magnetic field and frequency dependence in Si(100) inversion layers.

23731 (CBPF-NF—009/86) Influence of dilution and nature of the interaction on surface and interface magnetism. Tsallis, C. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1986. 36p. NTIS (US Sales Only), PC A03/MF A01. Order Number TI88701539/JAW.

The recent theoretical effort of the Rio de Janeiro/CBPF group on surface magnetism is tutorially reviewed. Within a real space renormalization group framework, we analyse the influence of factors such as the number of states per spin (q-state Potts model), the signs of the coupling constants (mixed ferro and antiferromagnetic interactions), the presence of a second semi-infinite bulk (interface case), the symmetry of the interaction (anisotropic Heisenberg model), and surface and/or bulk dilution (bond quenched model). A variety of interesting physical effects emerges. (Autor).

23732 (CBPF-NF—023/87) Criticality of the Potts ferromagnet in Midgal-Kadanoff - like hierarchical lattices. Silva, L.R. da; Tsallis, C. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1987. 31p. NTIS (US Sales Only), PC A03/MF A01. Order Number TI88701541/JAW.

Within the real space renormalisation group framework, we discuss the critical point and exponent ν of the Potts ferromagnet in b-sized Migdal-Kadanoff-like hierarchical lattices. Both $b \to \infty$ and $b \to 1$ limits are exhibited. The important discrepancies that might exist between the exact results for d-dimensional hierarchical lattices and d-dimensional Bravais lattices are illustrated.

23733 (CBPF-NF—044/87) On the geometrical interpretation of fracton and fractal dimensionalities. Tsallis, C.; Maynard, R. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro; Centre National de la Recherche Scientifique, 38 - Grenoble (France). Centre de Recherches sur les Tres Basses Temperatures). (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1987. 11p. NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701542/JAW.

We suggest that the Fourier-analysis of the elastic vibrations in fractals can be very enlightening for understanding the vibrational underlying fractal geometry.

23734 (CONF-871124—79) Electronic structure and antiferromagnetism in La_2CuO_4. Sterne, P.A.; Wang, C.S.; Stocks, G.M; Temmerman, W.M. (Maryland Univ., College Park (USA). Dept. of Physics; Oak Ridge National Lab., TN (USA); Daresbury Lab. (UK)). 1987. Contract AC05-84OR21400. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005843/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (30 Nov 1987).

Self-consistent spin-polarized energy bands have been calculated for tetragonal and orthorhombic La_2CuO_4. No stable antiferromagnetic order is found in either the stoichiometric compound or oxygen deficient La2CuO/sub 3.75/. Constraining the occupancy of Brillouin zone boundary states leads to a small antiferromagnetic moment in both systems which is rapidly quenched by Ba doping. 11 refs., 1 fig.

23735 (CONF-8710159—7) Dynamics and structure of energetic displacement cascades. Averback, R.S.; Diaz de la Rubia, T.; Benedek, R. (Illinois Univ., Urbana (USA). Dept. of Material Science; State Univ. of New York, Albany (USA). Dept. of Physics; Argonne National Lab., IL (USA)). Dec 1987. Contract W-31109-ENG-38;AC02-76ER01198. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005803/JAW.

From 12. international conference on atomic collisions in solids; Okayama, Japan (12 Oct 1987).

This paper summarizes recent progress in the understanding of energetic displacement cascades and the primary state of damage in metals. On the theoretical side, the availability of supercomputers has greatly enhanced our ability to simulate cascades by molecular dynamics. Recent application of this simulation technique to Cu and Ni provides new insight into the dynamics of cascade processes. On the experimental side, new data on ion beam mixing and in situ electron microscopy studies of ion damage at low temperatures reveal the role of the thermodynamic properties of the material on cascade dynamics and structure. 38 refs., 9 figs.

23736 (CONF-8710275—1) Interparticle interactions and polarization effects in colloids. Hayter, J.B. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 24p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005852/JAW.

From International conference on applications and techniques of small angle scattering; Argonne, IL, USA (26 Oct 1987).

The physics of simple colloidal systems is usually dominated by three independent length scales: the particle size, the average interparticle distance, and the range of the interparticle potential. The dispersed particles typically have characteristic dimensions in the range 5 to 100 nm, often with spherical or cylindrical symmetry. Dispersion densities vary over volume fractions ranging from 0.5 to 10^{-4}, with the corresponding mean interparticle distances ranging from about 1 to 10 diameters (in spherical systems). The interaction potential may be very short ranged (hard sphere), very long ranged (Coulomb or dipolar), or anywhere in between (screened Coulomb), and the correlations exhibited in the dispersion may be gas-like, liquid-like or crystalline, depending on the range of the potential relative to the interparticle distance. This rich phase behavior is responsible for the remarkable importance of colloidal studies in many areas of condensed matter physics and biophysics, but it poses often intractable problems in developing the statistical mechanical descriptions necessary for an understanding of scattering data from colloids. This paper will review the considerable recent progress in this field, in the context of SANS experiments on colloids in which the potentials are dominated by either screened Coulomb or magnetic dipolar interactions; in the case of magnetic colloids (ferrofluids), the use of polarization analysis will also be discussed. 32 refs., 4 figs.

23737 (DOE/ER/45200—3) Inelastic scattering in condensed matter with high intensity Mossbauer radiation: Progress report, March 1, 1985-October 31, 1987. Yelon, W.B.; Schupp, G. (Missouri Univ., Columbia (USA). Research Reactor Facility). Oct 1987. Contract FG02-85ER45200. 24p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006018/JAW.

A facility for high intensity Moessbauer scattering has been commissioned at the University of Missouri Research Reactor (MURR) as well as a facility at Purdue University using special isotopes produced at MURR. A number of scattering studies have been successfully carried out, including a study of the thermal diffuse scattering in Si, which led to an analysis of the resolution function for gamma-ray scattering. Also studied was the anharmonic motion in Na and the satellite reflection Debye-Waller factor in TaS_2 which indicates phason rather than phonon behavior. High precision, fundamental Moessbauer effect studies have also been carried out using scattering to filter unwanted radiation. These have led to a new Fourier transform method for describing Moessbauer effect (ME) lineshape. This method allows complete correction for source resonance self-absorption (SRSA) and the accurate representation of interference effects that add an asymmetric component to the ME lines. This analysis is important to both the funadmental ME studies and to scattering studies for which a deconvolution is essential for extracting the correct elastic fractions and lineshape parameters. These advances, coupled to our improvements in MIcrofoil Conversion Electron (MICE) spectroscopy, lay the foundation for the proposed research outlined in this request for a three-year renewal of DOE support.

23738 (ENEA-RT-TIB—84-29) Small angle neutron scattering study of ageing process in an Al-Mg-Si alloy. Abis, S.; Fiorini, P.; Boeuf, A.; Caciuffo, R.; Crico, S.; Magnani, M.; Stefanon, M.; Melone, S.; Puliti, P.; Rustichelli, F. (Istituto Sperimentale dei Metalli Leggeri, Novara (Italy); Commission of the European Communities, Ispra (Italy). Joint Nuclear Research Center; ENEA, Bologna (Italy). Dip. Tecnologie Intersettoriali di Base; Ancona Univ. (Italy)). (ENEA, Rome (Italy)). 1984. 21p. NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701562/JAW.

Small angle neutron scattering (SANS) measurements were performed on polycrystalline samples of high purity Al-Mg (0.72%)-Si (0.34%) alloy. The effect of different ageing temperature was observed and the results compared with information obtained using differen technique such as resistivity measurements and transmission electron microscopy. The results give useful information on the validity of SANS for the study of complex Al alloy. 31 refs; 20 figs.

23739 (HMI-P—87/7-HF(prepr.)) Production and thermal annealing of neutrino recoil induced Frenkel pairs in copper. Metzner, H.; Sielemann, R.; Klaumuenzer, S.; Hunger, E. (Hahn-Meitner-Institut Berlin G.m.b.H. (Germany, F.R.). Bereich Kern- und Strahlenphysik; Hahn-Meitner-Institut Berlin G.m.b.H. (Germany, F.R.). Bereich Kern- und Strahlenphysik; Freie Univ. Berlin (Germany, F.R.). Fachbereich Physik). 1987. 54p. Hahn-Meitner-Institut Berlin G.m.b.H. (Germany, F.R.).

/sup 111/In atoms which originate from /sup 111/Sn decays via electron capture start at the energy of 29 eV from substitutional lattice sites in otherwise undamaged copper and produce isolated single Frenkel pairs at 4.2 K. The observation of $\gamma\gamma$ perturbed angular correlations (PAC) following the decay of /sup 111/In to /sup 111/Cd yields the signal of the copper monovacancy of ν/sub Q/ = e/sup 2/Qq/h = 117 MHz (eta = 0). The thermal annealing behavior of the Frenkel pairs is studied by PAC in an isochronal (10 min) annealing program between 4.2 K and 300 K. Two distinct annealing steps are observed: Between 35 K and 48 K about 60% and between 250 K and 293 K the remaining 40% of the monovacancies vanish. The first step is due to the recombination of vacan-

cies with their own interstitial (correlated recombination), while the second one is caused by detrapping and free vacancy migration. Details of the process of Frenkel-pair production and consequences for defect models are discussed.

23740 **(IFUSP-P—657) Fluctuations on the Curie-Weiss version of the Ising Model with Random field.** Matos, J.M.G.A. de; Perez, J.F. (Sao Paulo Univ. (Brazil). Inst. de Fisica). Aug 1987. 12p. NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701584/JAW.

We show the fluctuations on the Curie-Weiss version of the Ising Model with Random Field to have either gaussian distribution with random mean away from criticality and at first order phase transition, or deterministic, non-gaussian distribution at other types of criticality.

23741 (INIS-BR—917, pp 25) **Neuron network memory capacity with multispin interaction.** Fontanari, J.F.; Koeberle, R. (Sao Paulo Univ., Sao Carlos, SP, Brazil. Inst. de Fisica e Quimica). 1987. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701458/JAW. (CONF-8709236—).

From 8. national meeting of particle physics and fields; Caxambu, MG, Brazil (16 Sep 1987).

23742 (INIS-BR—917, pp 25) **Curie-Weiss fluctuation for the Ising model with random field.** Matos, J.A. de; Perez, J.F. (Sao Paulo Univ., Brazil. Inst. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701458/JAW. (CONF-8709236—).

From 8. national meeting of particle physics and fields; Caxambu, MG, Brazil (16 Sep 1987).

23743 (INIS-BR—917, pp 25) **Global stability of the gaussian fixed point in two-dimensional Coulomb gases.** Marchetti, D.H.U.; Perez, J.F. (Sao Paulo Univ., Brazil. Inst. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701458/JAW. (CONF-8709236—).

From 8. national meeting of particle physics and fields; Caxambu, MG, Brazil (16 Sep 1987).

23744 (INIS-BR—917, pp 27) **Global stability of the Gaussian fixed point in the hierarchical model in d=3.** Pereira, E.A.; Schor, R.S. (Minas Gerais Univ., Belo Horizonte, Brazil. Dept. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701458/JAW. (CONF-8709236—).

From 8. national meeting of particle physics and fields; Caxambu, MG, Brazil (16 Sep 1987).

23745 (INIS-BR—934, pp 135) **Study of the influence of He-vacancy complexes in compounds formed in stainless steel 310 implanted with nitrogen.** Ramos, S.M.M.; Amaral, L.; Vasquez, A.; Behar, M.; Zawislak, F.C. 1987. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701471/JAW. (CONF-8708216—).

From 10. workshop on nuclear physics in Brazil; Caxambu, MG, Brazil (26 Aug 1987).

23746 (INIS-BR—934, pp 137) **Studies of interdiffusion and reactions induced by ionic bombardment in Fe-Al bilayers. Part 1. Analysis by Rutherford backscattering.** Vasconcellos, M.A.Z.; Teixeira, S.R.; Dionisio, P.H.; Schreiner, W.H.; Baumvol, I.J.R.; Freire Junior, F.L. (Rio Grande do Sul Univ., Porto Alegre, Brazil. Inst. de Fisica; Pontificia Univ. Catolica do Rio de Janeiro, Brazil. Dept. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701471/JAW. (CONF-8708216—).

From 10. workshop on nuclear physics in Brazil; Caxambu, MG, Brazil (26 Aug 1987).

23747 (INIS-BR—934, pp 138) **Studies of interdiffusion and reactions induced by ionic bombardment in Fe-Al bilayers. Part 2. Resistence of the foil and electron microscopy.** Teixeira, S.R.; Vasconcellos, M.A.Z.; Dionisio, P.H.; Schreiner, W.H.; Baumvol, I.J.R. (Rio Grande do Sul Univ., Porto Alegre, Brazil. Inst. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701471/JAW. (CONF-8708216—).

From 10. workshop on nuclear physics in Brazil; Caxambu, MG, Brazil (26 Aug 1987).

23748 (INIS-BR—934, pp 139) **Studies of interdiffusion and reactions induced by ionic bombardment in Fe-Al bilayers. Part 3. X-ray diffraction and conversion electron Moessbauer spectroscopy.** Vasconcellos, M.A.Z.; Teixeira, S.R.; Dionisio, P.H.; Schreiner, W.H.; Baumvol, I.J.R. (Rio Grande do Sul Univ., Porto Alegre, Brazil. Inst. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701471/JAW. (CONF-8708216—).

From 10. workshop on nuclear physics in Brazil; Caxambu, MG, Brazil (26 Aug 1987).

23749 (INIS-BR—934, pp 140) **Formation of Zr oxide in the electrolitic process and the distribution of dopants - An analysis by Rutherford backscattering.** Patnaik, B.K.; Barros Leite, C.V. de; Baptista, G.B.; Quinones, L.; Schweikert, E.A.; Magnussen, N.; Coke, D.L. (Pontificia Univ. Catolica do Rio de Janeiro, Brazil. Dept. de Fisica; Texas A and M Univ., College Station, USA. Dept. of Chemistry). 1987. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701471/JAW. (CONF-8708216—).

From 10. workshop on nuclear physics in Brazil; Caxambu, MG, Brazil (26 Aug 1987).

23750 (INIS-BR—934, pp 144) **Effects of hydrogenation-degassing cycles in the A151 304 stainless steel implanted with nitrogen.** Saavedra, A.; Elias, C.N.; Pascual, R. (Instituto Militar de Engenharia, Rio de Janeiro, Brazil. Secao de Engenharia e Ciencia dos Materiais). 1987. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701471/JAW. (CONF-8708216—).

From 10. workshop on nuclear physics in Brazil; Caxambu, MG, Brazil (26 Aug 1987).

23751 (INIS-BR—934, pp 120) **Ranges of implanted ions (10-400 KeV) in SiO/sub 2/.** Grande, P.L.; Fichtner, P.F.P.; Behar, M.; Livi, R.P.; Zawislak, F.C. (Rio Grande do Sul Univ., Porto Alegre, Brazil. Inst. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701471/JAW. (CONF-8708216—).

From 10. workshop on nuclear physics in Brazil; Caxambu, MG, Brazil (26 Aug 1987).

23752 (INIS-BR—934, pp 123) **Profiles of heavy ion implantation in amorphous carbon films.** Grande, P.L.; Fichtner, P.F.P.; Behar, M.; Amaral, L.; Livi, R.P.; Zawislak, F.C. (Rio Grande do Sul Univ., Porto Alegre, Brazil. Inst. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701471/JAW. (CONF-8708216—).

From 10. workshop on nuclear physics in Brazil; Caxambu, MG, Brazil (26 Aug 1987).

23753 (INIS-BR—934, pp 125) **Equilibrium ratio for hydrogen charge states. Measurements in metallic films evaporated in situ.** Freire Junior, F.L.; Castro Faria, N.V. de; Pinho, A.G. de; Kirsch, R. (Pontificia Univ. Catolica do Rio de Janeiro, Brazil. Dept. de Fisica; Lyon-1 Univ., 69, France). 1987. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701471/JAW. (CONF-8708216—).

From 10. workshop on nuclear physics in Brazil; Caxambu, MG, Brazil (26 Aug 1987).

23754 (INIS-BR—934, pp 133) **Thermal stability and Bi diffusion implanted in the AZiii photoresist.** Guimaraes, R.B.; Amaral, L.; Livi, R.P.; Souza, J.P. de; Behar, M.; Zawislak, F.C. (Rio Grande do Sul Univ., Porto Alegre, Brazil. Inst. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701471/JAW. (CONF-8708216—).

From 10. workshop on nuclear physics in Brazil; Caxambu, MG, Brazil (26 Aug 1987).

23755 (INIS-BR—934, pp 136) **Analysis of the α-particle implantation effect in compounds formed in the steel 1020 implanted with different doses of nitrogen.** Ramos, S.M.M.; Vasquez, A.; Amaral, L.; Behar, M.; Zawislak, F.C. 1987. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701471/JAW. (CONF-8708216—).

From 10. workshop on nuclear physics in Brazil; Caxambu, MG, Brazil (26 Aug 1987).

23756 (INIS-BR—934, pp 147) **Electron diffusion in liquids.** Malamut, C.; Paschoa, A.S.; Paes-Leme, P.J.S. (Instituto de Radioprotecao e Dosimetria, Rio de Janeiro, Brazil; Pontificia Univ. Catolica do Rio de Janeiro, Brazil. Dept. de Fisica; Pontificia Univ. Catolica do Rio de Janeiro, Brazil. Dept. de Matematica). 1987. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701471/JAW. (CONF-8708216—).

From 10. workshop on nuclear physics in Brazil; Caxambu, MG, Brazil (26 Aug 1987).

23757 (INIS-BR—947) **Influence of impurities on the polaron effective mass.** Lima, R.A.T. de. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1975. 91p. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. Order Number TI88701602/JAW.

Using the Green Function formalism, it is verified the Rodriguez's model for the effective mass of the polaron at finite temperature in the presence of 'traps'. Some aspects of this model were discussed. (M.W.O.).

23758 (INIS-BR—948) **Electron paramagnetic resonance of K/sub 3/Rh(CN)/sub 6/ irradiated with electrons in KCl.** Vugman, N.V. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). Jul 1970. 72p. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number TI88701603/JAW.

Using a simple theory, it was estimated the electronic density of the diamagnetic complex Rh (CN)/sup 3-//sub 6/ in a KCl lattice. The g// and g1 values were determined by EPR, and the experimental results fit the theoretical calculations. (M.W.O.).

23759 (INIS-mf—11123) **Two dimensional solid state NMR.** Kentgens, A.P.M. (Katholieke Univ. Nijmegen (Netherlands)). 4 Jun 1987. 175p. NTIS (US Sales Only), PC A08/MF A01. Order Number TI88701758/JAW.

Contains summary in Dutch.

This thesis illustrates, by discussing some existing and newly developed 2D solid state experiments, that two-dimensional NMR of solids is a useful and important extension of NMR techniques. Chapter 1 gives an overview of spin interactions and averaging techniques important in solid state NMR. As 2D NMR is already an established technique in solutions, only the basics of two dimensional NMR are presented in chapter 2, with an emphasis on the aspects important for solid spectra. The following chapters discuss the theoretical background and applications of specific 2D solid state experiments. An application of 2D-J resolved NMR, analogous to J-resolved spectroscopy in solutions, to natural rubber is given in chapter 3. In chapter 4 the anisotropic chemical shift is mapped out against the heteronuclear dipolar interaction to obtain information about the orientation of the shielding tensor in poly-(oxymethylene). Chapter 5 concentrates on the study of super-slow molecular motions in polymers using a variant of the 2D exchange experiment developed by us. Finally chapter 6 discusses a new experiment, 2D nutation NMR, which makes it possible to study the quadrupole interaction of half-integer spins. 230 refs.; 48 figs.; 8 tabs.

23760 (INIS-SU—433, pp 3-7) **Mathematical simulation of point defect interaction with grain boundaries.** Bojko, V.S. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1987. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780050/JAW.

Voprosy Atomnoj Nauki i Tekhniki.; no. 1(39).

In Radiation damage physics and science of materials.

Published works, where the interaction of point defects and grain boundaries was studied by mathematical simulation methods, have been analysed. Energetics of the vacancy formation both in nuclei of large-angle special grain boundaries and in lattice regions adjoining them has been considered. The data obtained permit to explain specific features of grain-boundary diffusion processes. Results of mathematical simulation of the interaction of impurity atoms and boundaries have been considered. Specific features of the helium atom interaction with large-angle grain boundaries are analysed as well. 17 refs.

23761 (INIS-SU—433, pp 10-11) **Effect of edge dislocation motion on its sink strength for point defects.** Zhukov, A.I. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1987. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780050/JAW.

Voprosy Atomnoj Nauki i Tekhniki.; no. 1(39).

In Radiation damage physics and science of materials.

Effect of edge dislocation motion on point defect flows to it has been investigated. It is shown that motion accountancy together with elastic field accountancy results in the increase of dislocation absorptivity asymmetry with respect to point defects of various kinds. 3 refs.

23762 (INIS-SU—433, pp 12-24) **On the effect of cascade creating radiation on the rate of segregations in oversaturated solid solutions.** Bakaj, A.S.; Turkin, A.A. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1987. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780050/JAW.

Voprosy Atomnoj Nauki i Tekhniki.; no. 1(39).

In Radiation damage physics and science of materials.

Diffusion relaxation of damage cascade in two-component substitution alloys is considered. It is shown that the relaxation of nonequilibrium distributions of point defects in the cascade region results in the formation of alloy component distribution inhomogeneity because of differences of partial diffusion coefficients. Local increase of oversaturation and increased diffusive atom mobility in the cascade region enhances the probability of appearance of stable particles of a new phase during the disintegration of solid substitution solutions. Dependence of the nucleation rate on irradiation parameters has been found. 20 refs.; 3 figs.

23763 (INIS-SU—433, pp 26-29) **Estimation of the degree of defect formation in boron containing materials under fast neutron irradiation.** Guldamashvili, A.I.; Golubkov, V.B.; Kuteliya, R.N.; Sadagashvili, N.I. 1987. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780050/JAW.

Voprosy Atomnoj Nauki i Tekhniki.; no. 1(39).

In Radiation damage physics and science of materials.

Estimation of the degree of defect formation in boron, boron carbide and aluminium dodecarbide in the numbers of displacements per atom (displ./at.) depending on fast neutron fluence in the range of 1x10/sup 20/...3.15x10/sup 23/ cm/sup -2/ and boron-10 isotope enrichment from 0 to 100% has been performed. It is shown that in the given range of neutron irradiation fluences the defect formation in materials under consideration coincides (within the limits of 10%). Increase of the number of displacements per atom 2-3 times at all irradiation fluences depends on the degree of boron-10 isotope enrichment in all the materials. For maximum fluence the number of displacements changes from 122 for natural enrichment to 202-208 displ./atom for 100% born-10 enrichment. A quantitative contribution introduced with separate elements in materials under consideration to the defect formation has been estimated. 7 refs.; 4 tabs.

23764 (INIS-SU—433, pp 48-49) **Study of annihilation of mixed dislocations of a/2 <111> type in tungsten lattice.** Bojko, V.S.; Mazilova, T.I. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1987. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780050/JAW.

Voprosy Atomnoj Nauki i Tekhniki.; no. 1(39).

In Radiation damage physics and science of materials.

Methods of mathematical simulation were used to investigate at an atomic level the nuclear annihilation process of mixed dislocations of a/2 < 111 > type in tungsten bcc lattice. Cases of dislocation arragement are considered both in the sae and in different slip planes. Radius of a certain annihilation (difference between dislocations after which achievement the loss of lattice stability between their nuclei occurs) has been determined for dislocations of the considered type lying in the same slip planes. Spontaneous motion of dislocation nuclei in opposite directions and their subsequent annihilation have been discovered as well. Loss of lattice stability between dislocations occurs when drawing together nuclei at a distance of about 1nm. After annihilation of dislocations lying in different slip planes a vacancy chan forms, this defect healing occurs by meas of atom displcement according to the type. Possible effect of point defects appearing during the dislocation annihilation on crystal radiation resistane is discussed. 5 refs.

23765 (INIS-SU—433, pp 50-52) **Preferable absorption of point defects by dislocation loops.** Zhukov, A.I. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1987. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780050/JAW.

Voprosy Atomnoj Nauki i Tekhniki.; no. 1(39).

In Radiation damage physics and science of materials.

Difference in absorptive power of rectilinear and curved dislocations (dislocation loops of a large radius) with provision for their elastic fields has been investigated. To find stationary flows of point defects, a perturbation theory has been developed according to a small parameter inversely proportional to a curvature radius. Trend to the preference decrease (asymmetry of absorptive power with respect to point defects of different kinds-vacancies and interstitials) of interstitial loops and to the increase of vacancy loop preference with the loop radius reduction has been discovered. 6 refs.

23766 (INIS-SU—433, pp 57-59) **Statistical equilibrium approximation of γ-quanta yield and energy losses by channeling protons in Nb-0,2 at % /sup 15/N crystal.** Deev, A.S.; Olejnik, V.A.; Svetashov, P.A.; Skakun, N.A. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1987. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780050/JAW.

Voprosy Atomnoj Nauki i Tekhniki.; no. 1(39).

In Radiation damage physics and science of materials.

Computer-aided design of rated gamma quanta yield from the /sup 15/N(p, αγ)/sup 12/C reaction on nitrogen atoms dissolved in niobium monocrystal has been performed within the framework of a model of continuous chains on condition of steady-state statistical equilibrium. To take account of energy losses of ions channelled along main crystallographic directions, the Lind-Khard expression, where channeled stopping power is related to electron concentration, which "is felt" with a channeled particle, as well as with criterion α of stopping locality, was used. Electron concentration in the channel has been obtained by means of averaging of electron local density on an area accessible for ion motion with the given transverse energy. The Moliere potential has been used, contribution of two first coordination spheres has been taken account of. Increase of beam angular divergence at the expense of multiple scattering with electrons has been allowed for. It was obtained: dependence of rated gamma quanta yield on scanning angle; dependence of yield maximum and angular half width of yield on difference between initial beam energy and reaction resonance energy. Satisfactory agreement of calculations and experimental data has been obtained at a parameter value α=0.5 predicted with Lindhardt. 5 refs.; 2 figs.

23767 (INIS-SU—433, pp 75-93) **Sputtering and inelastic processes.** Baranov, I.A.; Tsepelevic, S.O. (Radievyj Inst., Leningrad, USSR). 1987. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780050/JAW.

Voprosy Atomnoj Nauki i Tekhniki.; no. 1(39).

In Radiation damage physics and science of materials.

Experimental data and models of a new type of material sputtering with ions of relatively high energies due to inelastic (electron) processes are reviewed. This area of investigations began to develop intensively during the latest years. New experimental data of the authors on differential characteristics of ultradisperse gold and americium dioxide layers with fission fragments are given as well. Practical applications of the new sputtering type are considered as well as setup of possibl experiments at heavy multiply charged ion accelerators. 57 refs.; 16 figs.; 3 tabs.

23768 (INIS-SU—433) **Radiation damage physics and science of materials.** (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow; Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike, Moscow (USSR)). 1987. 118p. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780050/JAW.

Voprosy Atomnoj Nauki i Tekhniki.; no. 1(39).

Individual papers have been indexed separately. (WRF)

23769 (INIS-SU—443, pp 27-28) **Simulation of impurity-vacancy clusters in Ni.** Gann, V.V.; Marchenko, I.G. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1987. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88780053/JAW.

Voprosy Atomnoj Nauki i Tekhniki.; no. 2.

In Physics of radiation damages and radiation science of materials.

Formation energies and atomic configurations of impurity-vacancy, impurity-divacancy complexes have been investigated by computerized simulation. Impurity introduction is simulated by changing the atomic radius of the impurity in comparison with the atomic radius, R/sub 0/, of the matrix. It is shown that with the impurity radius more than 1.18 R/sub 0/ the impurity-divacancy complex transforms into the splitting configuration, in which the impurity atom is in the middle between two vacancies. This complex can become an effective centre of point defect recombination, when possessing light mobility and a large radius of capture.

23770 (INIS-SU—443, pp 38-41) **Anisotropy of spatial structure of primary radiation damages created by ion channeling.** Gann, V.V.; Dyul'dya, S.V.; Yudin, O.V. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1987. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88780053/JAW.

Voprosy Atomnoj Nauki i Tekhniki.; no. 2.

In Physics of radiation damages and radiation science of materials.

The spatial structure of nickel monocrystal primary radiation damages created by destructive channeling of nickel ion with 50 keV energy in the [100] channel has been investigated by the mathematical simulation method. It is shown that the channeling ion produces low-energy cascades of collisions localized in closepacked planes (100), being orthogonal to the channel axis, in the process of infinite transverse motion, approaching periodically to atomic chains at the distances, being less than the threshold impact parameter of formation of primary knocked-out atoms. In its turn, radiation damage in these planes possesses essential anisotropy caused by propagation of chains substituting collisions in close-packed directions of <011> type and (less commonly) <001>.

23771 (INIS-SU—443, pp 59-60) **Orientation effects in secondary particle yield at low energies.** Antipenko, A.P.; Bel'kovets, V.A.; Kasilov, V.I. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1987. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88780053/JAW.

Voprosy Atomnoj Nauki i Tekhniki.; no. 2.

In Physics of radiation damages and radiation science of materials.

Orientation deppendences under photon radiation for Si and W monocrystals are obtained at the NNF JINR electron accelerator with 36 MeV energy. Maximum increase of photon emission for Si is 10% and for W - 4%. The ratio of neutron yield in oriented case to the yield in case of strong disorientation has been measured for tungsten monocrystal. The measurement results showed that the neutron yield in oriented case was by 5.5% higher than in disoriented one.

23772 (INIS-SU—443, pp 61-62) **Phonon excitation on the development of a cascade of atom-atom collisions.** Gann, V.V.; Marchenko, I.G. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1987. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88780053/JAW.

Voprosy Atomnoj Nauki i Tekhniki.; no. 2.

In Physics of radiation damages and radiation science of materials.

Non-equilibrium phonon excitation has been investigated by the method of mathematical simulation. It is shown that the phonon shift to the region of low frequencies is observed when developing an atom-atom collision cascade. It may essentially affect the diffusion processes, dislocation slipping from their locks and dynamic frequency change in the cascade region of a damage.

23773 (INIS-SU—443/1, pp 45-47) **Electron-hole liquid in superconductivity superlattices of type 3.** Markova, N.V.; Silin, A.P. 1987. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88780053/JAW.

Kratkie soobshcheniya po fizike.; no. 3.

In Experimental and theoretical physics. Collection.

Binding energy and equilibrium density of electron-hole liquid in semiconducting superlattices of type 3, characterized by an indirect energy gap in the coordinate space, are calculated. 1 ref.

23774 (INIS-SU—443/1, pp 31-33) **To theory of plasma turbulent instability.** Bychenkov, V.Yu.; Silin, V.P. 1987. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88780053/JAW.

Kratkie soobshcheniya po fizike.; no. 3.

In Experimental and theoretical physics. Collection.

A new plasma hydrodynamic instability under irregular trasfer, conditioned by ion-acoustic turbulence, is detected. Conditions, under which the plasma is instable in relation to perturbations with frequencies lower than ion-acoustic one, are revealed. The hydrodynamic instability considered is important for laser plasma, as it leads to its turbulization. 3 refs.

23775 (LA—11232-MS) **Coulomb electrostatic contributions to the energy, pressure, bulk modulus, and stress-strain coefficients in the rock salt structure.** Straub, G.K. (Los Alamos National Lab., NM (USA)). Mar 1988. Contract W-7405-ENG-36. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006019/JAW.

The properties of a system of point ions on a regular crystalline lattice are discussed using the Ewald summation technique. This technique separates the real space coulomb interaction into a short ranged and long ranged part. The poorly converging long range terms are Fourier transformed and evaluated in reciprocal space. The electrostatic contributions to the energy, pressure, bulk modulus, and stress-strain coefficients are evaluated and given for the simple cubic, body-centered cubic, face-centered cubic, and rock salt structures. 2 refs., 2 tabs.

23776 (OUP—87-40) **Accurate structure factor determintation with electron diffraction.** Gjoennes, J.; Humpreys, C.J.; Steeds, J.W. (Oslo Univ. (Norway). Fysisk Inst.; Oxford Univ. (UK). Dept. of Metallurgy and Science of Materials; Bristol Univ. (UK). H.H. Wills Physics Lab.). (Oslo Univ. (Norway). Fysisk Inst.). Dec 1987. 14p. NTIS (US Sales Only), PC A03/MF A01. Order Number TI88752496/JAW.

A selection of methods for structure factor determination by electron diffraction is presented. Results obtained by the different methods are compared with regards to accuracy in structure factor determination. A comparison between measurements of structure factors for copper using electron diffraction methods as well as dynamical X-ray methods (fringes) and gamma ray methods is given. 19 refs.

23777 (OUP—87-41) **Measurement of structure factors and determination of crystal thickness by electron diffraction.** Gjoennes, J.; Steeds, J.W. (Oslo Univ. (Norway). Fysisk Inst.; Bristol Univ. (UK). H.H. Wills Physics Lab.). (Oslo Univ. (Norway). Fysisk Inst.). Dec 1987. 14p. NTIS (US Sales Only), PC A03/MF A01. Order Number TI88752497/JAW.

The paper is a survey of various methods for the measurement of structure factors and the determination of crystal thickness by electron diffraction. 30 refs.

23778 (UCRL—96492-Rev.1) **Three phase carbon EOS model with electronic excitation.** van Thiel, M.; Ree, F.H.; Grover, R. (Lawrence Livermore National Lab., CA (USA)). Jul 1987. Contract W-7405-ENG-48. 5p. (CONF-870753—56-Rev.1). NTIS, PC A02. Order Number DE87013789/JAW.

From 5. topical conference of the American Physical Society on shockwaves in condensed matter; Monterey, CA, USA (20 Jul 1987).

A simple and rapid way for computing EOS data of multiphase solids with a liquid phase is described with emphasis on carbon. The method uses a scaling model for the liquid phase and includes a provision for electronic effects. The free energy minimum determines the stable phase.

23779 **Critical properties of a spin-(1/2 chain with competing interactions.** Emery, V.J.; Noguera, C. (Brookhaven National Laboratory, Upton, New York 11973 Laboratoire de Physique des Solides, Universite de Paris-Sud, 91405 Orsay, France IBM Zurich Research Laboratory, 8803 Ruschlikon, Switzerland). *Physical Review Letters;* **60**: No. 7, 631-634(15 Feb 1988). Contract AC02-76CH00016.

The crossover between 2k/sub F/ and 4k/sub F/ charge-density waves in an extended one-dimensional Hubbard model is studied in the U→∞ limit by mapping onto a Heisenberg antiferromagnet with a competing second-neighbor Ising interaction. The phase diagram is obtained by a combination of field theory techniques and numerical solution of finite chains. Regions of staggered spin order (4k/sub F/ site or bond order) and (2,2) spin order (2k/sub F/ site order) are mapped out. Critical exponents in the algebraic phase are obtained.

23780 **Two-dimensional boundary conditions and finite-size effects in angle-resolved photoelectron emission spectroscopy, low-energy electron diffraction, and high-resolution electron-energy-loss spectroscopy.** Tong, S.Y.; Poon, H.C. (Laboratory for Surface Studies and Department of Physics, University of WisconsinMilwaukee, Milwaukee, Wisconsin 53201). *Physical Review* [*Section*] *B: Condensed Matter;* **37**: No. 6, 2884-2891(15 Feb 1988).

The plane-wave and spherical-wave boundary conditions across a vacuum-solid interface are derived for electron emission and diffraction spectroscopies. The proper boundary condition to be chosen across a realistic interface is determined. We also compare the exact form of inelastic electron damping with those of phenomenological models. We determine the errors in the latter. Finite-size effects in low-energy electron diffraction and high-resolution electron-energy-loss spectroscopy are determined.

23781 **Stability of bulk and pseudomorphic epitaxial semiconductors and their alloys.** Mbaye, A.A.; Wood, D.M.; Zunger, A. (Solar Energy Research Institute, Golden, Colorado 80401). *Physical Review* [*Section*] *B: Condensed Matter;* **37**: No. 6, 3008-3024(15 Feb 1988).

The Landau-Lifshitz theory of structural phase transitions permits identification of distinct classes of ordered ternary structures A/sub n/B/sub 4-n/C_4 (n = 0—4) whose structural units are the A/sub n/B/sub 4-n/C clusters spanning all possible nearest-neighbor environments in A/sub x/B/sub 1-x/C pseudobinary semi-

conductor alloys. A detailed description of how disordered bulk or epitaxial alloys may be described as a superposition of such clusters is given. Using Landau-Lifshitz structures as examples, the very different energetics of bulk-versus-epitaxial (ordered or disordered) ternary phases are described and investigated quantitatively via a simple valence-force-field model and harmonic elasticity theory. Under epitaxial conditions on a substrate of lattice constant a/sub s/, a tetragonal degree of freedom for a ternary ordered compound controls the curvature about the minimum of the energy E(a/sub s/), while cell-internal structural parameters control the minimum of E and hence stability. Stable bulk compounds when grown under epitaxial conditions may change in relative stability, permitting artificial stabilization of desired ordered phases. Exotic ordered ternary compounds unstable in bulk form (and hence not found in the bulk phase diagram) may become stable when epitaxy-induced strain is accommodated more successfully in the ternary than in the binary constituents; the occurrence of miscibility gaps and spinodal decomposition for disordered alloys may be similarly suppressed under epitaxial conditions.

23782 **Theory of ion-surface collisions: Case study of He/sup +/ projectile ion on TaC surface.** Kimura, Mineo; Lane, N.F.; Fujima, Kazumi; Sato, Hiroshi. (Argonne National Lab., IL, USA; Rice Univ., Houston, TX, USA; Rice Univ., Houston, TX, USA. Dept. of Physics; Rice Quantum Inst., Houston, TX, USA; Institute of Physical and Chemical Research, Wako, Saitama, Japan. Atomic Processes Lab). *Nuclear Instruments and Methods in Physics Research;* **262**: No. 1, 114-117(1 Dec 1987). (CONF-8703116—). Contract W-31-109-ENG-38.

From US-Japan seminar on interactions of highly ionized atoms produced in heavy-ion collisions; Kobe, Japan (1 Mar 1987).

A general physical picture of the collision dynamics of electron capture in ion-surface collisions at intermediate collision energies is given. The self-consistent-field Xα (SCF Xα) method is used to obtain potential surfaces for the collision system, and semiclassical calculations of the intensities of the scattered particles are carried out. The model describes reasonably well the recent experimental measurement of He/sup +/-TaC surface collisions.

23783 (JINR—D-3,4,17-86-747, pp 360-365) **Expected anomalies of the neutron cross section near the liquid-glass transition.** Gotze, W. (Technische Univ. Muenchen, Garching, Germany, F.R. Fakultaet fuer Physik; Max-Planck-Institut fuer Physik und Astrophysik, Muenchen, Germany, F.R.). 1987. NTIS (US Sales Only), PC A21/MF A01. Order Number DE88780064/JAW. (CONF-8610176—).

From 5. international school on neutron physics; Alushta, USSR (20 Oct 1986).

In the frameworks of a microscopic theory the anomalies of the neutron cross section near the liquid-glass transition are discussed. The central concept of the theory is the correlation function for density fluctuations of wave vector q and frequency ω. Its absorptive part is proportional to the dynamical structure factor S(q, ω), this is the scattering law for coherent neutron scattering. Tagged particle motion is evaluated as well and it yields the incoherent neutron scattering cross section S/sub i/(q, ω) in. The predictions of the theory for S(q, ω) and Si (q, ω) a q-ω domain are given. 3 refs.; 2 figs.

23784 (JINR—D-3,4,17-86-747, pp 425-435) **Neutron scattering on helical magnetic structures.** Izyumov, Yu.A. (AN SSSR, Sverdlovsk. Inst. Fiziki Metallov). 1987. (In Russian). NTIS (US Sales Only), PC A21/MF A01. Order Number DE88780064/JAW. (CONF-8610176—).

From 5. international school on neutron physics; Alushta, USSR (20 Oct 1986).

Thermodynamics of simulated structures is analysed, any of which can be considered as a long-periodic modulation of a certain initial ferro- or antifferomagnetic structure. This modulation period cannot be usually compared to the period of crystal lattice, therefore such structures are often colled incomparable. Analysis of behaviour of a structure in the form of a simple spiral with the temperature change is given, for which Landau phase transition theory is used. Neutron elastic scattering, magnetic structure excitation spectra and neutron inelastic scattering are considered. 8 refs.; 7 figs.

23785 (JINR—D-3,4,17-86-747) **5. School on neutron physics. Lectures.** (Joint Inst. for Nuclear Research, Dubna (USSR)). 1987. 500p. (CONF-8610176—). NTIS (US Sales Only), PC A21/MF A01. Order Number DE88780064/JAW.

From 5. international school on neutron physics; Alushta, USSR (20 Oct 1986).

Individual papers have been indexed separately. (WRF)

6561 Superconductivity

REFER ALSO TO CITATION(S) 22002, 22003, 22048, 22051, 22052, 22069, 22083, 22250

23786 (KFKI—1987-49/E) **Positron annihilation study on Y-Ba-Cu-O high T/sub c/ superconductors.** Balogh, A.G.; Liszkay, L.; Molnar, B.; Puff, W. (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics; Technische Univ., Graz (Austria). Inst. fuer Kernphysik). (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). Aug 1987. 6p. NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701763/JAW.

Submitted to Phys. Rev. Lett. (US).

First positron annihilation measurements are reported on high T/sub c/ superconductor YBa/sub 2/Cu/sub 3/O/sub 7-x/. The lifetime and Doppler broadening spectra show a slight but significant change about 240K suggesting a deviation from the normal structure far above 90K where the resistance falls to zero.

23787 (KFTI—87-21) **Effect of high-amplitude high-frequency current on non-isothermal equilibrium of NS-boundary in inhomogeneous superconductor.** Bezuglyj, A.I.; Shklovskij, V.A. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1987. 24p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701682/JAW.

Effect of high-amplitude high-frequency current and the arbitrary shape on averaged in oscillations non-isothermal equilibrium of the vibrating interphase boundary in a long superconductor has been theoretically investigated using the phenomenological approach based on the equation of a thermal balance and dependence of the superconductor critical temperature on the current value. The averaged self-consistent temperature field of fast-oscillating non-isothermal NS-boundary (thermal kink) allowing to go out beyond the limits of the known conception of mean-square heating and to take into account the effect of a current oscillation shape. It is established that in case of current oscillations, being alternate pulses of the reversed polarity, NS-boundary, being originally in equilibrium, will drift to N-phase, if their shape becomes stronger when the pulse amplitude being fixed. Stronger pulses lead to motion of the interphase boundary in the S-phase region when current efficiency being fixed (i.e. heat release in the normal region). In case of current pulses of a sufficiently plane shape it is established that the width of the kink oscillation region has an order of the known heat length. Classifications of experiments on high-power SHF radiation effect on volt-ampere characteristics (VAC) of superconducting films is carried out in the paper; VAC families for inhomogeneous superconductors, where current runs with high-frequency component of a large amplitude, are constructed. It is shown that nonlinear VAC stages are related to the presence in the film a local domain near inhomogeneity, which length changes with the high-frequency current component amplitude change. Series of VAC has hystheresis of thermal nature. 14 refs.; 7 figs.

6570 Theoretical And Mathematical Physics

REFER ALSO TO CITATION(S) 22281, 23332, 23686, 23833, 23838, 23970

23788 (AD-A—186938/7/XAB) **United States - Japan seminar on quantum-mechanical aspects of quantum electronics held in Monterey, California on 21-24 July 1987.** Shapiro, J.H.; Takuma, H. (Massachusetts Inst. of Tech., Cambridge (USA). Research Lab. of Electronics). Oct 1987. 662p. NTIS, PC A99/MF A01.

Partial contents include: Manipulation and Spectroscopy of Atoms; Nonlinear and Excitonic Optics; Stable Lasers; Squeezed States; Dynamic Studies in Semiconductors; Spectroscopy, Instability and Multistability; Quantum light and Quantum photodetection.

23789 **(DESY—87-014) Path integrals on curved manifolds.** Grosche, C.; Steiner, F. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.); Hamburg Univ. (Germany, F.R.). 2. Inst. fuer Theoretische Physik). Feb 1987. 32p. Also published in Z. Phys., C (Nov 1987) v. 36(4) p. 699-714.

A general framework for treating path integrals on curved manifolds is presented. We also discuss how to perform general coordinate and space-time transformations in path integrals. The main results is that one has to subtract a quantum correction ΔV proportional to Planck constant/sup 2/ from the original Lagrangian L, i.e. the correct effective Lagrangian to be used in the path integral is L/sub eff/ = L - ΔV. A general prescription for calculating the quantum correction is given. It is based on a canonical approach using the Hamiltonian path integral. The crucial point is the use of an appropriate Hamiltonian which is uniquely determined if the correct hermitian momentum operators are introduced. Our quantum correction differs in general from the various expressions proposed by previous authors. The general framework is illustrated by several examples: the d-dimensional rotator, i.e. the motion on the sphere S/sup d-1/, the path integral in d-dimensional polar coordinates, the exact treatment of the hydrogen atom in R/sup 2/ and R/sup 3/ by performing a Kustaanheimo-Stiefel transformation, the Langer transformation and the path integral for the Morse potential.

23790 **(DOE/ER/40374—3) Multiple scaling and the fine structures of period doubling.** Mao, Jian-min; Hu, Bambi. (La Jolla Inst., CA (USA). Center for Studies of Nonlinear Dynamics; Houston Univ., TX (USA). Dept. of Physics). 19 Jan 1987. Contract AC03-84ER40182;FG05-87ER40374. 16p. (LJI-P—85-356). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006072/JAW.

Generalizing the simple scaling law for period doubling, we have studied a multiple scaling law which describes the fine structures of period doubling. For one-dimensional dissipative maps, two-dimensional area-preserving maps and four-dimensional symplectic maps, the multiple scaling law is seen to be well obeyed. New scaling exponents have also been found. The multiple scaling is also seen to be a powerful tool for searching for scaling behavior. 9 refs., 1 fig., 2 tabs.

23791 **(ENEA-RT-TIB—87-7) A generalization of the self filtering unstable resonator.** Di Lazzaro, P.; Hermsen, T.; Zheng, C.E. (ENEA, Rome (Italy)). Jul 1987. 15p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751896/JAW.

We will present some calculations on a generalization of the Self Filtering Unstable Resonator (SFUR). The resonator is no longer confocal, and in principle, one may have a shorter cavity length, while the other properties remain almost the same.

23792 **(IFUSP-P—650) On the second order Virial coefficient and the relationships between Quantum and Classical statistics and scattering.** Hussein, M.S.; Wreszinski, W.F. (Sao Paulo Univ. (Brazil). Inst. de Fisica). Jul 1987. 15p. NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701582/JAW.

We clarify some aspects of the relationship between quantum statistical mechanics and scattering theory, which show up in their simplest form in the behaviour of the second-order virial coefficient b/sub 2/. For this purpose we derive a new representation for b/sub 2/. The relationship with classical statistical mechanics is also illuminated by a recently obtained formula for the difference between the classical and quantum second order virial coefficients which allows the determination of the leading quantum correction to b/sub 2/. The several approaches represent alternative ways of implementing the cancellation of divergences in b/sub 2/.

23793 **(IFVE-OTF—87-8) Bogolyubov transformation in relativistic theory of gravitation.** Solov'ev, V.O.; Tverskoj, V.B. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. 11p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701592/JAW.

The gravitational field is quantized on the base of the canonical formalism of the Relativistic Theory of Gravitation by means of Bogolyubov tansformation. The translational-invariant scheme of the perturbation theory has been constructed. The Hamiltonian is obtained in the zero-order over coupling constant. 8 refs.

23794 (INIS-BR—917, pp 9) **Propagator for a time dependent mass particle under a time dependent frequence harmonic potential.** Souza, C.F. de; Souza Dutra, A. de. (Rio de Janeiro Univ., Brazil. Inst. de Fisica; Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1987. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701458/JAW. (CONF-8709236—).

From 8. national meeting of particle physics and fields; Caxambu, MG, Brazil (16 Sep 1987).

23795 (INIS-BR—917, pp 18) **Hydrogen and Litium- A Wigner superoscillator system in four dimensions.** Jayaraman, J. (Paraiba Univ., Joao Pessoa, Brazil. Dept. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701458/JAW. (CONF-8709236—).

From 8. national meeting of particle physics and fields; Caxambu, MG, Brazil (16 Sep 1987).

23796 (INIS-BR—917, pp 18) **Differential step operators of high orders for the harmonic espectrum of radial anharmonic oscillators in three dimensions.** Lima Rodrigues, R. de; Jayaraman, J. (Paraiba Univ., Joao Pessoa, Brazil. Dept. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701458/JAW. (CONF-8709236—).

From 8. national meeting of particle physics and fields; Caxambu, MG, Brazil (16 Sep 1987).

23797 (INIS-BR—917, pp 20) **On a class of stationary metrics in general relativity.** Moraes Paiva, F. de; Reboucas, M.J.; Fonseca Teixeira, A.F. da. (Rio de Janeiro Univ., Brazil; Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1987. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701458/JAW. (CONF-8709236—).

From 8. national meeting of particle physics and fields; Caxambu, MG, Brazil (16 Sep 1987).

23798 (INIS-BR—917, pp 20) **Matrix formulation of general relativity.** Maluf, J.W. (Brasilia Univ., Brazil). 1987. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701458/JAW. (CONF-8709236—).

From 8. national meeting of particle physics and fields; Caxambu, MG, Brazil (16 Sep 1987).

23799 (INIS-BR—917, pp 22) **Neutrinos gravitational coupling with matter vorticity.** Rodrigues, L.M.C.S.; Soares, I.D. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1987. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701458/JAW. (CONF-8709236—).

From 8. national meeting of particle physics and fields; Caxambu, MG, Brazil (16 Sep 1987).

23800 (INIS-BR—934, pp 36) **Comparison between Wigner and gaussian packets representations.** Nielsen, M.; Toledo Piza, A.F.R. de. (Pontificia Univ. Catolica de Sao Paulo, Brazil. Dept. de Fisica; Sao Paulo Univ., Brazil. Inst. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701471/JAW. (CONF-8708216—).

From 10. workshop on nuclear physics in Brazil; Caxambu, MG, Brazil (26 Aug 1987).

23801 (INIS-mf—10567, pp 97-108) **Perturbative grist for the variation mill: wedding the two approximation techniques.** Kauffmann, S.K.; Perez, S.M. (Cape Town Univ., South Africa). 1986. NTIS (US Sales Only), PC A12/MF A01. Order Number DE87701986/JAW. (CONF-8607120—; CONF-8507150—).

From 21. annual seminar on theoretical physics; Johannesburg, South Africa (8 Jul 1986).

The papers on the 20th and 21st annual seminars on theoretical physics are bound in one volume.

Perturbation theory is shown to be a natural source of stationary and minimum principles for a wide variety of physical quantities in quantum mechanics. This opens the way to direct variational optimisation of these quantities, in contrast to the traditional Rayleigh-Ritz method, which variationally optimises only the ground state energy. Moreover, the perturbative source of these new variational principles permits their systematic refinement via the inclusion of higher order terms. The price paid for this substantial generalisation of the variational method is having to deal with complicated perturbative expressions, which include infinite sums over intermediate states. Some circumstances under which these sums can be formally carried out are discussed.

23802 (INIS-mf—10567, pp 91-96) **New vector constants of motion for the hydrogen atom.** De Lange, O.L.; Raab, R.E. (Natal Univ., Pietermaritzburg, South Africa). 1986. NTIS (US Sales Only), PC A12/MF A01. Order Number DE87701986/JAW. (CONF-8607120—; CONF-8507150—).

From 21. annual seminar on theoretical physics; Johannesburg, South Africa (8 Jul 1986).

The papers on the 20th and 21st annual seminars on theoretical physics are bound in one volume.

It is known for the non-relativistic Coulomb problem that the orbital angular momentum L and the Pauli-Lenz vector A are conserved. New conserved vectors B^{+-} are presented and it is shown that A + i B^{+-} are ladder operators for the quantum numbers n, and l and m, in the eigenkets chemical bondnlm> of the commuting operators H, L^2, L/sub z/. Other properties of B^{+-} are also discussed.

23803 (INIS-mf—10567, pp 213-246) **Deformations in boson systems and the preservation of symmetries.** Scholtz, F.G. (Univ. of Stellenbosch, South Africa). 1986. NTIS (US Sales Only), PC A12/MF A01. Order Number DE87701986/JAW. (CONF-8607120—; CONF-8507150—).

From 21. annual seminar on theoretical physics; Johannesburg, South Africa (8 Jul 1986).

The papers on the 20th and 21st annual seminars on theoretical physics are bound in one volume.

A simple boson system with an SO(2) symmetry is considered. An intrinsic subspace containing the intrinsic excitations of the system is identified by means of an eigenstate of the position operators. This makes it possible to calculate excitational energies and moments of inertia while the symmetry is treated exactly. The group theoretical considerations underlying this approximation are discussed in detail. This is constrasted with the random phase approximation which is also cast in a group theoretical framework.

23804 (INIS-mf—10567, pp 247-256) **Seniority bosons from similarity transformations.** Geyer, H.B. (Univ. of Stellenbosch, South Africa). 1986. NTIS (US Sales Only), PC A12/MF A01. Order Number DE87701986/JAW. (CONF-8607120—; CONF-8507150—).

From 21. annual seminar on theoretical physics; Johannesburg, South Africa (8 Jul 1986).

The papers on the 20th and 21st annual seminars on theoretical physics are bound in one volume.

The requirement of associating in the boson space seniority with twice the number of non-s bosons defines a similarity transformation which re-expresses the Dyson pair boson images in terms of seniority bosons. In particular the fermion S-pair creation operator is mapped onto an operator which, unlike the pair boson image, does not change the number of non-s bosons. The original results of Otsuka, Arima and Iachello are recovered by this procedure while at the same time they are generalized to include g-bosons or even bosons with J>4 as well as any higher order boson terms. Furthermore the seniority boson images are valid for an arbitrary number of d- or g-bosons - a result which is not readily obtainable within the framework of the usual Marumori- or OAI-method.

23805 (INIS-SU—4/A) **Beam waves in random inhomogeneous media.** Bass, F.G.; Pritula, G.M. (AN Ukrainskoj SSR, Kharkov. Inst. Radiofiziki i Ehlektroniki). 1986. 44p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number TI88701631/JAW.

Preprint-N--320.

Propagation and non-stabilities of waves excited by a beam of charged particles are considered in media with fluctuations of dielectric permitivity at different suggestions concerning their statistic properties. 44 refs.; 3 figs.

23806 (INIS-SU—443/1, pp 21-24) **On the effective potential in quantum mechanics with non-Abelian gauge symmetry.** Solov'eva, M.A. 1987. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88780053/JAW.

Kratkie soobshcheniya po fizike.; no. 3.

In Experimental and theoretical physics. Collection.

Gauge SO(N)-model, describing the Yang-Mills spatially homogeneous field dynamics at N=3 is considered. The ground state within high N limits is calculated using a collective coordinate method. It is shown, that in contrast to a collective, the effective potential in the orbit space in this model is unlimited from below. 10 refs.

23807 (INIS-SU—443/1) **Experimental and theoretical physics. Collection.** (AN SSSR, Moscow. Fizicheskij Inst.). 1987. 49p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88780053/JAW.

Kratkie soobshcheniya po fizike.; no. 3.

Individual papers have been indexed separately. (WRF)

23808 (ITEF—43(1987)) **Monte Carlo modified method for Green function. Algorithm and computer code for calculations in equal mass many-body system.** Polikarpov, M.I.; Shevchenko, L.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 30p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701114/JAW.

The description and the test program for the Monte-Carlo modified method for the Green functions are given. The program is designed for calculations in equal mass many-body systems with any interaction potential, which is assigned in the program. The number of particles in the program is a parameter, the form of the equations solved and calculated is unique for any number of particles. A pair Cornel potential to calculate systems consisting in 3, 6, 9, 12 light quarks is used for a concrete case given in the paper. As a result, energies of basic states, the wave function and the wave function square of the low state are calculated. 10 refs.; 1 fig.

23809 (ITEF—122(1987)) **1/n-expansion and wave functions.** Mur, V.D.; Pozdnyakov, S.G.; Popov, V.S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 24p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701639/JAW.

1/n expansion is applied to calculation of wave functions. Analytical formulae, true for arbitrary smooth potential V(r) including coefficients determining the behaviour of wave function X/sub e/(r) at r -> 0 and r -> ∞, have been derived. An approximate formula for effective radius r/sub e/ at the moment of appearance of related l-level (E=0) has been derived as well. These formulae are asymptotically-accurate at l -> ∞. Comparison with numerical calculations (for power potentials, funnel and Yukawa potential) shows that the applicability area is expanded up to low l/sub s/. 24 refs.; 4 tabs.

23810 **(ITEP—69(1987)) Hyperellyptic statsums in superstring theory.** Morozov, A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 7p. NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701646/JAW.

Expression for holomorphic measure on the module space of hyperellyptic Riemann surfaces is proposed, which possesses modular properties required for statistical sum of superstring. 4 refs.

23811 **(JINR-E—5-86-524) Free Laplacian with attractive boundary conditions.** Englisch, H.; Schroeder, M.; Seba, P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1986. 12p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87702971/JAW.

The motion of a free quantum particle on the half space R/ sup n-1/xR/sub +/ is considered. The dependence of surface states on the boundary conditions is investigated and the results are compared with those obtained by a Schroedinger operator with attractive short-range potential in the neighbourhood of the boundary. It is also shown that for a sufficiently attractive boundary a collapse of the system occurs. 17 references.

23812 **(JINR-R—2-85-183) Relativistic two-body system with proper time axis on the interaction surface.** Shavokhina, N.S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1985. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87702977/JAW.

Submitted to the sbornik Problemy teorii gravitatsii i ehlementarnykh chastits.

In the reltivistic problem of two bodies with a modulo constant interaction force the case is considered, when the proper time axis lies on the interaction surface. A system of differential equations with a deviating argument is derived, in which the searched quantity also is the very deviation of the argument. 6 references.

23813 **(JINR-R—2-86-354) Generalized coherent states for three-dimensional relativistic oscillator model.** Atakishiev, N.M.; Mir-Kasimov, R.M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1986. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87702980/JAW.

Submitted to the journal J. Phys. A: Math. Gen. and to the Organizing Comittee of the 9. International seminar on high-energy and field theory physics (Protvino, Jul 1986).

The SU(1, 1) coherent states for a relativistic model of the oscillator in the configurational r-representation are considered. Classical equations of motion in the generalized phase space are obtained with the help of the path integral for the transition amplitude between SU(1, 1)CS. It is shown that the use of the semiclassical Bohr - Sommerfeld quantization rule yields the exact expression for the energy levels. 14 references.

23814 **(JINR-R—2-86-478) Two identities for the second Beltrami differential parameter.** Chernikov, N.A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1986. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87702981/JAW.

Two identities are proved for the second differential Beltrami parameter. The conditions of harmonicity are written in three equivalent forms. Comparison is made for these conditions in works by A.Einstein and V.A.Fock. 5 references.

23815 **(JINR-R—2-87-324) Spectroscopy of a singular linear oscillator.** Avakyan, M.R.; Pogosyan, G.S.; Ter-Antonyan, V.M.; Sisakyan, A.N. (Erevanskij Gosudarstvennyj Univ. (USSR); Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701661/JAW.

Submitted to the journal Phys. Lett., A.

It is shown that the delta-shaped term $V(x)=\Omega\delta(x)$ changes radically the linear oscillator spectroscopy and in some limiting cases leads to the production of anomalous double degenerate energy levels for the one-dimensional quantum mechanics and to the falling of a particle on the centre. 9 refs.; 1 fig.

23816 **(JINR-R—4-86-573) Solution of Faddeev-Yakubovsky differential equations by the finite-dimensional approximation method for four spinless particles in the 1+3 scattering problem.** Belyaev, V.B.; Kochkin, V.I.; Kartavtsev, O.I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1986. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87702983/JAW.

By means of the method of finite-dimensional approximation of the differential operator in Yakubovsky equations the problem of determining the length of 1+3 scattering for four spinless particles is investigated. The pair potential of the Gaussian type was applied in the calculations. The scattering length has been found to be a/ sub (4)/=-5.88 Fm. 8 references, 1 table.

23817 **(JINR-R—11-87-261) Numerical solution of quasipotential eqiation with nonlinear entry of spectral parameter.** Zhidkov, E.P.; Sidorov, A.V.; Skachkov, N.B.; Khoromskij, B.N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1987. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701674/JAW.

The results of numerical investigation of relativistic quasipotential equations describing the coupled two-particle system in momentum space are presented for the case when integral operator contains the nonlinear dependence on the eigenvalue-mass of the system $M=2\lambda$. The dependence of the couple energy on the mass of intermediate boson μ is found. Critical values of mass μ for which the first bound state arises is calculated. 7 refs.; 4 figs.

23818 **(KFKI—1987-60/A) Strong coupling expansions for repulsive cut-off potentials.** Dolinszky, T. (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). Sep 1987. 23p. NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701769/JAW.

The WBK approximation is known to become for a large class of potentials exact in the strong coupling limit. In the present paper this theorem is generalized by developing exact expansions of the scattering quantities (wave function, Jost function, phase shift) in terms of the inverse powers of the coupling constant. The absolutely convergent series are obtained by iterating integral equations of scattering, the Green function of which is constructed of two independent solutions of a WKB differential equation.

23819 **(LAFI—100) Large order perturbation theory for hydrogen atom in a remote charge field.** Damburg, R.; Propin, R.; Martyshchenko, V.; Sil'verston, G. (AN Latvijskoj SSR, Riga. Inst. Fiziki). 1986. 21p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701688/JAW.

One of the most elementary problems of quantum mechanics is considered. There studied high order perturbation theory (HOPT) for the arbitrary state of hydrogen atom in a remote charge field. For the first time asymptotic expansions in terms of the HOPT series coefficient numbers have been obtained. Thus, a more specific problem concerning the coefficient signs in case the numbers are large has unambiguously been solved. 6 refs.; 19 tabs.

23820 **(PPPL—2494) SPARK Version 1.1 user manual.** Weissenburger, D.W. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Jan 1988. Contract AC02-76CH03073. 142p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88006255/JAW.

This manual describes the input required to use Version 1.1 of the SPARK computer code. SPARK 1.1 is a library of FORTRAN main programs and subprograms designed to calculate eddy currents on conducting surfaces where current flow is assumed zero in the direction normal to the surface. Surfaces are modeled with triangular and/or quadrilateral elements. Lorentz forces produced by the interaction of eddy currents with background magnetic fields can be output at element nodes in a form compatible with most structural analysis codes. In addition, magnetic fields due to

eddy currents can be determined at points off the surface. Version 1.1 features eddy current streamline plotting with optional hidden-surface-removal graphics and topological enhancements that allow essentially any orientable surface to be modeled. SPARK also has extensive symmetry specification options. In order to make the manual as self-contained as possible, six appendices are included that present summaries of the symmetry options, topological options, coil options and code algorithms, with input and output examples. An edition of SPARK 1.1 is available on the Cray computers at the National Magnetic Fusion Energy Computer Center at Livermore, California. Another more generic edition is operational on the VAX computers at the Princeton Plasma Physics Laboratory and is available on magnetic tape by request. The generic edition requires either the GKS or PLOT10 graphics package and the IMSL or NAG mathematical package. Requests from outside the United States will be subject to applicable federal regulations regarding dissemination of computer programs. 22 refs.

23821 Scattering from an attractive delta-function potential. Van Siclen, C.D. (Idaho National Engineering Laboratory, P. O. Box 1625, Idaho Falls, Idaho 83415). *American Journal of Physics;* **56**: No. 3, 278-280(Mar 1988).

A one-dimensional calculation is carried out to determine the phase shifts for scattering from an attractive delta-function potential. (AIP)

23822 Impossibility of a simple derivation of the Schwarzschild metric. Gruber, R.P.; Price, R.H.; Matthews, S.M.; Cordwell, W.R.; Wagner, L.F. (3318 Elm Street, Oakland, California 94609). *American Journal of Physics;* **56**: No. 3, 265-269(Mar 1988).

The Schwarzschild metric, the general relativistic description of the space-time outside a spherical mass, has an extremely simple appearance. Because of this many attempts have been made to derive it by combining special relativity with concepts of Newtonian gravitation. It is shown here that such a derivation is impossible. A general discussion is given of the relationship of relativistic gravitation and its Newtonian limit with special emphasis on a particular non-Newtonian effect: spatial curvature.

23823 Flat-sample and limited-field effects in integrating sphere measurements. Tardy, H.L. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of the Optical Society of America A: Optics and Image Science;* **5**: No. 2, 241-245(Feb 1988). Contract AC04-76DP00789.

The effect of large, flat diffuse samples on integrating sphere measurements is calculated exactly, based on an extension of the integral equation formalism of Jacquez and Kuppenheim [J. Opt. Soc. Am. 45, 460 (1955)]. The theory is further extended to include the effect of a limited detector field of view, and examples for different sphere configurations are provided. A variation of Taylor's method for absolute reflectance measurements is presented that has the advantage of an improved signal-to-noise ratio.

23824 Scattering by a sphere and reflection by a slab: some notable similarities. Bohren, C.F. (Pennsylvania State University, Meteorology Department, University Park, Pennsylvania). *Applied Optics;* **27**: No. 2, 205-206(15 Jan 1988).

The volumetric scattering by a sphere is determined using calculations for slabs. (AIP)

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REFER ALSO TO CITATION(S) 22301, 22302, 22387, 22409, 22531, 22541, 23279, 23338, 23721, 23723, 23727, 23923, 23940

23825 (DOE/ER/13449—8) Investigation of parameters critical to muon-catalyzed fusion: Performance report, May 19-August 31, 1987: [Final technical report]. Jones, S.E.; Palmer, E.P.; Thorne, J.M.; Mueller, B.; Rafelski, J.; Anderson, A.N. (Brigham Young Univ., Provo, UT (USA); Frankfurt Univ. (Germany, F.R.). Inst. fuer Theoretische Physik; Trois Torrents (Switzerland); Idaho Research, Inc., Idaho Falls (USA)). 20 Nov 1987. Contract FG02-85ER13449. 7p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88005801/JAW.

We have demonstrated (in conjunction with our colleagues) that muon catalysis cycling rates increase rapidly with increasing deuterium-tritium gas temperatures and densities. Furthermore, muon-capture losses are significantly smaller than predicted before the experiments began, although recent theoretical work narrows the gap between theory and observation. As a result of these effects, we have been able to achieve muon-catalyzed fusion yields of 150 fusions/muon (average). The fusion energy thereby released, nearly 3 GeV/muon, significantly exceeds theoretical expectations, and still higher yields are expected. Therefore, we are exploring the limits of muon-catalyzed fusion, to provide answers to questions regarding energy applications of muon-catalyzed fusion.

23826 (DOE/ER/53201—T3) Helical ripple transport in stellarators at low collision frequency. Beidler, C.D. (Wisconsin Univ., Madison (USA). Torsatron/Stellarator Lab.). Dec 1987. Contract FG02-85ER53201;FG02-86ER53216. 157p. (TSL—87-7). NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE88006431/JAW.

Numerical and analytical techniques have been developed to investigate the plasma transport which is due to particles trapping/detrapping in the local helical ripple wells of a stellarator's magnetic field. This process is of considerable importance as it provides the dominant transport mechanism in a stellarator plasma at "low" collision frequency: that is, when the frequency with which a particle is collisionally detrapped from a local ripple well is less than the bounce frequency of the particle in that well. A form of the longitudinal adiabatic invariant, J, is constructed and shown to describe accurately the orbits of ripple trapped particles. Unlike previous expressions for J, the form derived here correctly accounts for the local toroidal variation of the magnetic field. The expression for J is incorporated into a rapid "hybrid" Monte Carlo simulation of ripple transport in stellarators. The simulation is a hybrid in the sense that particle orbits in the narrow region of phase space on either side of the ripple trapping/detrapping boundary are followed using guiding center equations of motion while orbits in the remainder of phase space are described using adiabatic invariants. An analytical expression for the distribution function of ripple trapped particles in a stellarator - valid at all low collision frequencies - has been obtained by series solution of the bounce - averaged kinetic equation. This solution has been applied to both 'standard' and a class of 'transport optimized' stellarator magnetic fields. Analytical estimates of the diffusion coefficient obtained from the series solution show excellent agreement with the numerical results of the hybrid Monte Carlo code in all cases studied. 55 refs., 30 figs.

23827 (DOE/ER/53201—T4) Propagator solutions of partial differential equations applied to plasma transport. Hitchon, W.N.G.; Koch, D.J.; Adams, J.B. (Wisconsin Univ., Madison (USA). Torsatron/Stellarator Lab.). Nov 1987. Contract FG02-85ER53201. 26p. (TSL—87-4). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006432/JAW.

A variety of partial differential equations may be solved efficiently and easily, using a single algorithm which is based on the propagator (or Green's function) for equations of the Fokker-Planck type. The numerical method employed is always at least as

fast as finite differencing, but is especially efficient in cases where flow dominates over diffusion, and is consequently potentially widely applicable in fluid dynamics. Two transport problems in a small toroidal magnetic confinement device (IMS) have been considered. First, the ion distribution function and the potential in the sheath were calculated in the presence of charge exchange collisions for a wide range of neutral densities. Second, radial particle transport was modeled allowing for strong convection in the bulk plasma, and the density $n(r,\theta)$ was obtained for various plausible forms of the flow velocity, consistent with the observed average radial velocity. The best agreement with experiment is obtained with a vertical flow, which is also suggested by the measured potential profiles. 17 refs., 10 figs., 1 tab.

23828 **(DOE/ET/51013—225) Evolution of poloidal variation of impurity density and ambipolar potential in rotating tokamak plasma: Part 1.** Sigmar, D.J.; Zanino, R.; Hsu, C.T. (Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center). Sep 1987. Contract AC02-78ET51013. 17p. (PFC/RR—87-8). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006263/JAW.

When the beam driven toroidal plasma rotation reaches thermal velocity the particle density and the ambipolar potential can develop strong poloidal variations in the flux surface. The rapid time evolution of the thermal velocity, the change in toroidal plasma rotation, and the plasma flow velocity components in the flux surface are calculated. These results are evaluated numerically using a spectral code to describe the strong poloidal couplings. Results are compared to data from the ASDEX tokamak.

23829 **(DOE/ET/51013—230) Suitability of millimeter-wave scattering for diagnostics of fusion alpha-particles.** Woskov, P.P. (Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center). Sep 1987. Contract AC02-78ET51013. 33p. (PFC/RR—87-16). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006262/JAW.

Collective Thomson scattering using long-pulse, millimeter-wave sources is potentially a powerful diagnostic technique of localized alpha particle velocity distribution and density in a fusion tokamak. The combination of a long-pulse and long-wavelength source optimizes the achievable signal to noise ratio of this diagnostic. Additional advantages of millimeter-waves include large scattering angles up to 180°, wide-bandwidth receivers, and suitability of millimeter waveguide techniques in a radiation environment. The Doppler broadened scattered spectrum provides an unambiguous measure of the alpha particle parameters even for a scattering plane orientation near perpendicular to the magnetic field because magnetized particle resonances will be averaged out by finite diagnostic beam divergence and frequency resolution. Millimeter-wave accessibility in tokamaks using x-mode propagation at frequencies between the lower x-mode cutoff and the upper hybrid resonance may be a natural consequence of high field tokamak operation. 45 refs., 8 figs., 1 tab.

23830 **(DOE/ET/51013—242) Current-drive on the Versator-II tokamak with a slotted-waveguide fast-wave coupler.** Colborn, J.A. (Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center). Nov 1987. Contract AC02-78ET51013. 104p. (PFC/RR—87-20). NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88006261/JAW.

A slotted-waveguide fast-wave coupler has been constructed, without dielectric, and used to drive current on the Versator-II tokamak. Up to 35 kW of net microwave power at 2.45 GHz has been radiated into plasmas with $2 \times 10^{12} cm^{-3} \leq$ mean of n/sub e/ $\leq 1.2 \times 10^{13} cm^{-3}$ and B/sub tor/ $\simeq 1.0$ T. The launched spectrum had a peak near N/sub parallel/ $= -2.0$ and a larger peak near N/sub parallel/ $= 0.7$. Radiating efficiency of the antenna was roughly independent of antenna position except when the antenna was at least 0.2 cm outside the limiter, in which case the radiating efficiency slightly improved as the antenna was moved farther outside. When the coupler was inside the limiter, radiating efficiency improved moderately with increased mean of n/sub e/. Current-drive efficiency was comparable to that of the slow wave and was not affected when the antenna spectrum was reversed; however, no current was driven for mean of n/sub e/ $\leq 2 \times 10^{12} cm^{-3}$. These results indicate the fast wave was launched, but a substantial part of the power may have been mode-converted to the slow wave, possibly via a downshift in N/sub parallel/, and these slow waves may have been responsible for most of the driven current. Relevant theory for waves in plasma, current-drive efficiency, and coupling of the slotted-waveguide is discussed, the antenna design method is explained, and future work, including the construction of a much-improved probe-fed antenna, is described. 42 refs., 45 figs.

23831 **(DOE/ET/53088—304) Observations on energy transport in tokamaks: A new formula for turbulent transport.** Zhang, Y.Z.; Mahajan, S.M. (Texas Univ., Austin (USA). Inst. for Fusion Studies). Dec 1987. Contract FG05-80ET53088. 20p. (IFSR—304). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005309/JAW.

Arguments for a new, modified Ohkawa type formula of anomalous electron energy transport due to electromagnetic microturbulence are presented and its predictions are compared with tokamak experiments. 47 refs., 4 figs.

23832 **(DOE/ET/53088—305) Toroidal electron temperature gradient drive drift modes.** Horton, W.; Hong, B.G.; Tang, W.M. (Texas Univ., Austin (USA). Inst. for Fusion Studies; Princeton Univ., NJ (USA). Plasma Physics Lab.). Dec 1987. Contract FG05-80ET53088. 33p. (IFSR—305). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006380/JAW.

The electron temperature gradient in tokamak geometry is shown to drive a short wavelength lower hybrid drift wave turbulence due to the unfavorable magnetic curvature on the outside of the torus. Ballooning mode theory is used to determine the stability regimes and the complex eigenfrequencies. At wavelengths of order the electron gyroradius the polarization is electrostatic and the growth rate is greater than the electron transit time aroud the torus. At longer wavelengths of order the collisionless skin depth the polarization is electromagnetic with electromagnetic vortices producing the dominant transport. The small scale electrostatic component of the turbulence produces a small by (m/sub e/m/sub i/)/sup 1/2/ drift wave anomalous transport of both the trapped and passing electrons while the c/ω/sub pe/ scale turbulene produces a neo-Alcator type transport from the stochastic diffusion of the trapped electrons. 15 refs., 5 figs.

23833 **(DOE/ET/53088—310) Exact nonlinear travelling solutions of the Vlasov-Maxwell system.** Mahajan, S.M. (Texas Univ., Austin (USA). Inst. for Fusion Studies). Feb 1988. Contract FG05-80ET53088. 7p. (IFSR—310). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88006314/JAW.

Exact time dependent solutions of a system of charged particles with their self-consistent electromagnetic fields are obtained by solving the fully nonlinear Vlasov-Maxwell set of equations. 4 refs.

23834 **(GA-A—18987) Operation and calibration of the DIII-D grating radiometer.** Moeller, C.; Lohr, J. (GA Technologies, Inc., San Diego, CA (USA)). Sep 1987. Contract AC03-84ER51044. 13p. (CONF-8709157—5). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005696/JAW.

From Joint workshop on electron cyclotron emission and the electron cyclotron resonance heating; Oxford, UK (16 Sep 1987).

The DIII-D ECE ten channel grating radiometer is coupled to its antenna by a low loss single mode transmission system covering the 90 to 140 GHz band. This transmission system also acts as a low pass filter to eliminate higher order responses from the radiometer during calibration. At each end of the transmission system, a conversion to fundamental mode guide is made, ensuring that the radiometer and antenna propagate only a single mode. The conical horn antenna is fed from the fundamental TE_{11} mode, so that a narrow antenna pattern is obtained with a horn of small diameter. The horn can be valved off from the vacuum vessel and rotated for calibration. At the radiometer, just before the horn which illuminates the grating, the TE_{10} rectangular fundamental mode signal is modulated at 100 kHz, during both normal operation and calibration, eliminating 1/f electronic noise, drift, and neutron offset,

while providing a 10 kHz video response. This paper describes the measured properties of the transmission system, the mm wave modulator, the grating instrument, and the 100 kHz electronics. The signal to noise ratio during calibration and normal operation is discussed. The discrimination of the system against wavelengths passed by the higher order responses of the grating is examined. Comparisons are made of temperature profiles measured by Thomson scattering and by the independently calibrated radiometer.

23835 **(IAE—4441/7) Measurement of time evolution of plasma electron component parameters on the Ogra-4 device by the Thomson scattering method.** Tarabrin, Yu.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1987. 17p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701575/JAW.

Measurements of time evoluition of electron distribution function in the "Ogra-4" device are described. Measurements were conducted with the use of laser diagnostics complex, operating in pulse-periodic conditions. Time evolution of plasma electron component density and energy distribution of electrons was measured. The presence of intense oscillations of plasma density during the "Ogra-4" device operation without injection of neutrals is shown. Accumulation of two groups of cold electrons with energies of tens and hundreds of electron-volt take s place in the center of the trap after injection initiation. It is expained consistently by formation of the positive potential during accumulation of hot ions, confined by magnetic field. Thus, Thomson scattering measuremet provided data on accumulation of hot ion component. 14 refs.; 11 figs.

23836 **(IAE—4460/7) Corpuscular plasma diagnostics complex on a tokamak with a strong field.** Kislyakov, A.I.; Krasil'nikov, A.V.; Petrov, M.P.; Romannikov, A.N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1987. 16p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701576/JAW.

A project of corpuscular diagnostics complex for a tokamak with a strong field is considered. The complex comprises atomic particle analysers of several types and a neutral atom diagnostics injector DINA-4. Mathematical model for calculation of neutrals concentration distribution in the tokamak plasma with diagnostic beam and without it is proposed. Based on this model, charge-exchange atom spectra, recorded by corpuscular analysers, are produced, the complex capabilities, physical problems, which may be solved, using this complex, are determined. 14 refs.

23837 **(INIS-BR—953) Plasma formation in TBR.** Del Bosco, E. (Sao Paulo Univ. (Brazil). Inst. de Fisica). 1981. 155p. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. Order Number TI88701607/JAW.

In this work are presented and discussed results of the formation and equilibrium of the plasma current in TBR, a small tokamak, designed and contructed at the Instituto de Fisica of Universidade de Sao Paulo. The measured breakdown curves for H/sub 2/, A and He are compared with the predictions of a simple model with reasonable agreement. The influence of stray magnetic fields in the plasma formation is investigated and conditions are chosen to facilitate the breakdown. The time profile of loop voltage and plasma current for shots with plasma equilibrium are shown. A comparison is made between experimental results and analytical-numerical model for tokamaks discharges with ohmic heating. Reasonable agreement is obtained when Z, effective atomic number, is assumed as a parameter.

23838 **(INIS-mf—10567, pp 1-12) Remarks on determinants and the classical polynomials.** Henning, J.J. 1986. (In Afrikaans). NTIS (US Sales Only), PC A12/MF A01. Order Number DE87701986/JAW. (CONF-8607120—; CONF-8507150—).

From 21. annual seminar on theoretical physics; Johannesburg, South Africa (8 Jul 1986).

The papers delivered on the 20th and 21st annual seminars on theoretical physics are bound in one volume.

In this study methods are introduced that relate to elementary but fairly unknown functional relationships between power sums and coefficients of polynomials. These relationships, also called Waring functions, are derived. They are then used in other applications to give explicit expressions for the generalized Laguerre polynomials in terms of determinant functions. The properties of polynomials generated by a wide class of generating functions are investigated. These relationships are also used to obtain explicit forms for the cumulants of a distribution in terms of its moments. It is pointed out that cumulants (or moments, for that matter) do not determine a distribution function. An application of this is made on the theory of microinstabilities and electromagnetic waves in plasmas.

23839 (INIS-SU—443/1, pp 28-30) **Measuring timing characteristics of charged prticle fluxes on the PF-150 device being correlated with neutron and X-radiation yield.** Denus, S.; Chekaj, S.; Sledzin'skij, S. 1987. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88780053/JAW.

Kratkie soobshcheniya po fizike.; no. 3.

In Experimental and theoretical physics. Collection.

Preliminary results of measuring the charged particle fluxes (electrons and ions) with high time (3 ns) and spectral resolution (up to keV units depending on the range), correlated with time dependence of neutron and x-radiations at PF-150 device, are presented. NE-102 scintillator, its thickness being 200 μm, was used in beta-spectrograph as electron detector. A scintillator, its thickness being 400 μm, was used in magnetic spectrograph, detecting ions. The following conclusions are drawn: electron flux comprises several (usually 2 or 3) spikes; a later spike contains harder electrons; hard x-radiation correlates with electron pulse; ion pulse is usually much higher in duration than the electron one; neutron pulse correlates with the ion one. 3 refs.

23840 **(KFKI—1987-51/D) Impurity injection into tokamak plasmas by erosion probes.** Hildebrandt, D.; Bakos, J.S.; Buerger, G.; Paszti, F.; Petravich, G. (Akademie der Wissenschaften der DDR, Berlin. Zentralinstitut fuer Elektronenphysik; Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). Aug 1987. 19p. NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701765/JAW.

Exposing special erosion probes into the edge plasma of MT-1 the impurities Li and Ti were released and contaminated the plasma. By the use of collector probes the torodial transport of these impurities were investigated. The results indicate a preferential impurity flow into codirection of the plasma current. However, the asymmetric component of this flow is much larger than expected from the toroidal drift correlated to the plasma current.

23841 **(KFTI—86-14) Nonlinear stage of ion-acoustic pack evolution in current plasma.** Bakaj, A.S.; Maslov, V.I. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1986. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703008/JAW.

Evolution of a quasi-monochromatic ion-acoustic packet in a collisionless current-carrying plasma has been considered. A small difference between group and phase velocities leads to a number of special of process. In particular, the resonance particles that are reflected from the front of the packet play an essential role. The evolution equations have been obtained to describe the nonlinear stage of the process for the oscillation frequency of trapped particles greater than the rate of change of amplitude. It is found that the modulation instability is developed by untrapped particles for comparation instability is developed by untrapped particles for comparatively small amplitudes of the packet. This instability results in packet splitting into widely spaced short perturbations. Numerical simulation data and experimental results are discussed. 10 references.

23842 **(KFTI—86-25) Numerical research of dispersion properties of plasma cylindrical waveguides located in magnetic field.** Berezin, A.K.; Zemlyanskij, N.M.; Mirnyj, V.I.; Onishchenko, I.N.; Sotnikov, G.V. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1986. 20p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703009/JAW.

By numerical solution the dispersion properties of metallic waveguides partially filled up with cylindrical plasma or tube plasma of finite wall thickness placed into an infinite heavy magnetic field under different values of plasma density and radius of the conducting shells is studied. A dispersion dependence of cylindrical waveguide, partially filled with plasma and placed into the finite magnetic field, on the magnetic field intensity and on a degree of waveguide filling up with plasma is studied. A radial structure of the electric and magnetic fields of slow plasma wave is considered in such waveguides. It is shown that the control of wave phase of plasma density, and the considerable Poynting vector fluxes occur in the range of small values of longitudinal wave number. 9 references, 16 figures.

23843 **(KFTI—87-17) Nonlinear dynamics of interaction between charged particles modulated beam and bounded plasma regular oscillations.** Balakirev, V.A.; Ostrovskij, A.O. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1987. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701681/JAW.

Dynamics of modulated in density charged particle flux interaction with oscillations of a plasma resonator has been investigated. It is shown that under conditions when the resonator length is comparable with reversed spatial increment the stationary state is not established. The wave amplitude makes periodical oscillations. 10 refs.; 3 figs.

23844 **(KGI-PREPR—094) Comments on the theory of absolute and convective instabilities.** Oscarsson, T.; Roennmark, K. (Kiruna Geophysical Inst. (Sweden)). Oct 1986. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number TI88752490/JAW.

The theory of absolute and convective instabilities is discussed and we argue that the basis of the theory is questionable, since it describes the linear development of instabilities by their behaviour in the time asymptotic limit. In order to make sensible predictions on the linear development of instabilities, the problem should be studied on the finite time scale implied by the linear approximation. (authors).

23845 **(KGI-PREPR—095) Evolution of spectral densities in weakly inhomogeneous plasmas.** Roennmark, K. (Kiruna Geophysical Inst. (Sweden)). Oct 1986. 21p. NTIS (US Sales Only), PC A03/MF A01. Order Number TI88752491/JAW.

Theoretical studies of waves and instabilities are often performed for an infinite, homogeneous plasma, and the results are given in terms of eigenmodes (plane waves) extending over all space. Real plasmas are however always finite and inhomogeneous, and observations of waves in space are normally presented as frequency power spectra which depend on the time and place of observation. The purpose of this study is to reconcile these apparently disparate descriptions of plasma waves. A model describing inhomogeneous spectral densities in a homogeneous plasma is first discussed in some detail. When this model is generalized to inhomogeneous plasmas, it is found that the incompressibility of the spectral densities in k-space results in a remarkably simple transfer equation. A method which allows the observable frequency power spectrum to be calculated from a space and time dependent dispersion relation and appropriate boundary conditions, is also outlined.

23846 (LRP—324/87, pp 1-4) **Study of the plasma dynamic response to alfven wave heating power modulation in TCA.** Joye, B.; Lister, J.B.; Moret, J.M. (Centre de Recherche en Physique des Plasmas, Lausanne, Switzerland). Jun 1987. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88900372/JAW. (CONF-870629—Exc.).

From 14. European conference on controlled fusion and plasma physics; Madrid, Spain (22 Jun 1987).

Studies of the dynamic response of the plasma to a modulated Alfven Wave Heating (AWH) power have been performed on TCA. Radial analysis of the Soft-X ray flux modulation exhibits features similar to that of the sawtooth activity. Inside the q=1 surface, a constant phase shift is observed, while outside this radius the delay becomes important. The Alfven Wave resonance layer structure has not yet been demonstrated to influence the phase profile. The power modulation has a strong effect on both the period and the crash amplitude of the sawteeth.

23847 (LRP—324/87, pp 5-8) **Detailed effects of the excited wave spectrum in alfven wave heating on TCA tokamak.** Duval, B.P.; Howling, A.A.; Joye, B.; Lister, J.B.; Moret, J.M.; Ryter, F. (Centre de Recherches en Physique des Plasmas, Lausanne, Switzerland). Jun 1987. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88900372/JAW. (CONF-870629—Exc.).

From 14. European conference on controlled fusion and plasma physics; Madrid, Spain (22 Jun 1987).

The launching of Alfven Waves (AW) in the TCA Tokamak always causes a strong increase in density. Therefore the excited spectrum evolves and its effects manifest themselves on many plasma parameters. Variations in the plasma column resistance, $\beta + li/2$ and MHD activity are clearly related to the Alfven spectrum and may indicate a modification of the current profile.

23848 (LRP—324/87, pp 9-12) **Study of the broadband magnetic turbulence in the TCA tokamak.** Ryter, F.; Pochelon, A.; Hofmann, F. (Centre de Recherches en Physique des Plasmas, Lausanne, Switzerland). Jun 1987. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88900372/JAW. (CONF-870629—Exc.).

From 14. European conference on controlled fusion and plasma physics; Madrid, Spain (22 Jun 1987).

Poloidal structures of magnetic turbulence are studied and their persistence along the magnetic lines is analyzed. This can give an estimate of the minor radii of the observed turbulence.

23849 (LRP—324/87, pp 13-16) **Turbulent density fluctuations in the TCA tokamak.** Weisen, H.; Behn, R.; Hollenstein, C. (Centre de Recherches en Physique des Plasmas, Lausanne, Switzerland). Jun 1987. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88900372/JAW. (CONF-870629—Exc.).

From 14. European conference on controlled fusion and plasma physics; Madrid, Spain (22 Jun 1987).

This paper summarizes the results of their investigation on the spectral characteristics, spatial structure and scaling with plasma parameters of low frequency density fluctuations in ohmically heated TCA plasmas (B/sub phi/=1.5T, R=61 cm, a=18 cm, I/sub p/ $\leqq$ 170kA, anti n/sub e/ $\leqq$ 10^{14} cm^{-3}, T/sub e/(0) similarly ordered 800 eV) using the phase contrast method. This imaging method is suitable for the investigation of fluctuations in a wide band of wave numbers, 0.5 $\leqq$ k/sub perpendicular to/ $\leqq$ 20 rad/cm for the measurements presented. It uses a 23 x 4 cm wide CO_2 laser beam transmitted through the plasma and produces an image where the small phase shifts (phi $\leqq$ 10^{-3} radians) due to refractive perturbations are revealed as corresponding intensity variations which are detected by liquid nitrogen cooled HgCdTe detectors. In the wave number range of interest the device is equivalent to a fast high resolution interferometer with high sensitivity ($\sim$ 10^{-5} radians for $\Delta f = 1$MHz).

23850 **(ORNL/TM—10617) Transport simulations of ohmic ignition experiment: IGNITEX.** Uckan, N.A.; Howe, H.C. (Oak Ridge National Lab., TN (USA)). Dec 1987. Contract AC05-84OR21400. 22p. (CONF-871007—88). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006055/JAW.

From 12. symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

The IGNITEX device, proposed by Rosenbluth et al., is a compact, super-high-field, high-current, copper-coil tokamak envisioned to reach ignition with ohmic (OH) heating alone. Several simulations of IGNITEX were made with a 0-D global model and with the 1-D PROCTR transport code. It is shown that OH igni-

tion is a sensitive function of the assumptions about density profile, wall reflectivity of synchrotron radiation, impurity radiation, plasma edge conditions, and additional anomalous losses. In IGNITEX, OH ignition is accessible with nearly all scalings based on favorable OH confinement (such as neo-Alcator). Also, OH ignition appears to be accessible for most (not all) L-mode scalings (such as Kaye-Goldston), provided that the density profile is not too broad (parabolic or more peaked profiles are needed), Z/sub eff/ is not too large, and anomalous radiation and alpha losses and/or other enhanced transport losses (eta/sub i/ modes, edge convective energy losses, etc.) are not present. In IGNITEX, because the figure-of-merit parameters are large, ignition can be accessed (either with OH heating alone or with the aid of a small amount of auxiliary power) at relatively low beta, far from stability limits. Once the plasma is ignited, thermal runaway is prevented naturally by a combination of increased synchrotron radiation, burnout of the fuel in the plasma core and replacement by thermal alphas, and the reduction in the thermal plasma confinement assumed in L-mode-like scalings. 12 refs., 5 figs., 1 tab.

23851 (TRITA-PFU—86-11) Utilization of (/alpha/,n) and (/alpha/,/alpha/''/gamma/) reactions for measurement of fast alpha particle confinement and velocity distribution. Andersson, G. (Royal Inst. of Techn., Stockholm (Sweden). Dep. of Plasma Physics and Fusion Research). (Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics and Fusion Research). Oct 1986. 25p. NTIS (US Sales Only), PC A03/MF A01 - Also available from:Royal Inst. of Techn.,Library,S-10044 Stockholm (Sweden). . Order Number TI88752503/JAW.

For the purpose of diagnosing alpha particle confinement and velocity distribution in fusion plasmas we consider several (/alpha/,n) and (/alpha/,/alpha/''/gamma/) reactions with impurities or introduced elements. Flux and energy spectra of emerging particles are calculated under different conditions. Account is also taken of the high neutron and gamma background. Finally, we conclude that, due to the nature of the alpha particles, one needs to utilize several reactions and different kinds of diagnostics to fully explore the confinement and velocity distribution of the alpha particles.

23852 (TRITA-PFU—86-12) Instability due to magnetic viscosity in perpendicular MHD. Faghihi, M.; Scheffel, J.; Spies, G.O. (Royal Inst. of Techn., Stockholm (Sweden) Dep. of Plasma Physics and Fusion Research; Max Planck Inst. fuer Plasmaphysik, Garching (Germany,F.R.)). (Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics and Fusion Research). Mar 1987. 9p. NTIS (US Sales Only), PC A02/MF A01 - Also available from:Royal Inst. of Techn.,Library,S-10044 Stockholm (Sweden). . Order Number TI88752504/JAW.

The Perpendicular MHD model predicts exponentially growing Alfven waves in a static, homogeneous plasma equilibrium with isotropic pressure when gyroviscosity is included. (authors).

23853 (TRITA-PFU—87-04) Effect of gyroviscosity on the small axial wavelength internal kink instability in the Z-pinch. Scheffel, J.; Faghihi, M. (Royal Inst. of Techn., Stockholm (Sweden). Dep. of Plasma Physics and Fusion Research). (Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics and Fusion Research). Mar 1987. 20p. NTIS (US Sales Only), PC A03/MF A01 - Also available from:Royal Inst. of Techn.,Library,S-10044 Stockholm (Sweden).. Order Number TI88752506/JAW.

The effect of ion gyroviscosity on the stability of m=1 small axial wavelength kinks in a z-pinch with purely poloidal magnetic field is investigated by normal mode methods. We use the Incompressible FLR MHD model; a collisionless fluid model introduced to include Finite Larmor Radius effects. For vanishing Larmor radius, a stability criterion which coincides with that of ideal MHD is found; the Kadomtsev criterion 2rdp/dr+m/sp2/B/sp2///my//sb0/> or = 0. This criterion predicts instability unless the current density becomes singular at the centre of the pinch. When the Larmor radius terms of the ion pressure tensor are included, we find that marginally unstable (ideal) modes are stabilized. (authors).

23854 (UCLA/PPG—1128) Fusion core start-up, ignition and burn simulations of reversed-field pinch (RFP) reactors. Chu, Yuh-Yi. (California Univ., Los Angeles (USA). Dept. of Mechanical, Aerospace and Nuclear Engineering). Jan 1988. Contract FG03-86ER52126. 166p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE88006606/JAW.

A transient reactor simulation model is developed to investigate and simulate the start-up, ignition and burn of a reversed-field pinch reactor. The simulation is based upon a spatially averaged plasma balance model with field profiles obtained from MHD quasi-equilibrium analysis. Alpha particle heating is estimated from Fokker-Planck calculations. The instantaneous plasma current is derived from a self-consistent circuit analysis for plasma/coil/eddy current interactions. The simulation code is applied to the TITAN RFP reactor design which features a compact, high-power-density reversed-field pinch fusion system. A contour analysis is performed using the steady-state global plasma balance. The results are presented with contours of constant plasma current. A saddle point is identified in the contour plot which determines the minimum value of plasma current required to achieve ignition. An optimized start-up to ignition and burn path can be obtained by passing through the saddle point. The simulation code is used to study and optimize the start-up scenario. In the simulations of the TITAN RFP reactor, the OH-driven superconducting EF coils are found to deviate from the required equilibrium values as the induced plasma current increases. This results in the modification of superconducting EF coils and the addition of a set of EF trim coils. The design of the EF coil system is performed with the simulation code subject to the optimization of trim-coil power and current. In addition, the trim-coil design is subject to the constraints of vertical-field stability index and maintenance access. A power crowbar is also needed to prevent the superconducting EF coils from generating excessive vertical field. A set of basic results from the simulation of TITAN RFP reactor yield a picture of RFP plasma operation in a reactor. Investigations of eddy current are also presented. 145 refs., 37 figs., 2 tabs.

23855 (UPTEC—8701R) General long wavelength instability for Z-pinches and for Extrap within the Hall model. Aagren, O. (Uppsala univ. (Sweden). Inst. of Technology). (Uppsala Univ. (Sweden). Inst. of Technology). Jan 1987. 22p. NTIS (US Sales Only), PC A03/MF A01. Order Number TI88752508/JAW.

The stability of long wavelength perturbations is analyzed within the framework of the Hall model. Free boundary modes with m=1 and ksub(z) /arrow/ 0 are shown to be unstable for all pressure profiles which goes to zero at the plasma surface. The growth rate of the instability increases with decreasing plasma radius. Similar results are found for Extrap. Nonlinearities in combination with losses at the X-points are possibly responsible for the stability of free boundary modes in Extrap.

23856 (UPTEC—8704R) Finite Larmor radius effects on the stability properties of internal modes of a z-pinch. Aakerstedt, H.O. (Uppsala univ. (Sweden). Inst. of Technology). (Uppsala Univ. (Sweden). Inst. of Technology). Jan 1987. 46p. NTIS (US Sales Only), PC A03/MF A01. Order Number TI88752509/JAW.

From the Vlasov-fluid model a set of approximate stability equations describing the stability of a cylindrically symmetric z-pinch is derived. The equations are derived in the limit of small gyroradius and include first order kinetic effects such as finite ion Larmor radius effects and resonant ion effects. Neglecting the resonant ion terms, we explicitly solve this set of equations for a constant current density profile leading to a dispersion relation. FLR effects are shown for the case of m=1 internal mode to be stabilizing and for large wavenumbers k, using a trial function approach, absolute stabilization is found.

23857 (UPTEC—8705R) Stability properties of a toroidal z-pinch in an external magnetic multipole field. Eriksson, H.G. (Uppsala univ. (Sweden). Inst. of Technology). (Uppsala Univ. (Sweden). Inst. of Technology). Jan 1987. 36p. NTIS (US Sales Only), PC A03/MF A01. Order Number TI88752510/JAW.

MHD stability of m=1, axisymmetric, external modes of a toroidal z-pinch immersed in an external multipole field (Extrap configuration) is studied. The description includes the effects of a weak toroidicity, a non-circular plasma cross-section and the influence of induced currents in the external conductors. It is found that the non-circularity of the plasma cross-section always has a destabilizing effect but that the m=1 mode can be stabilized by the external feedback if the non-circularity is small.

23858 (UPTEC—8741R) Classical transport in a non-circular z-pinch. Eriksson, G. (Uppsala univ. (Sweden). Inst. of Technology). (Uppsala Univ. (Sweden). Inst. of Technology). May 1987. 35p. NTIS (US Sales Only), PC A03/MF A01. Order Number TI88752511/JAW.

A method is devised, in which particle and heat fluxes are found by solving the heat balance equation self-consistently for specified profiles. The procedure is applied to an equilibrium which corresponds to a non-circular z-pinch.

23859 Experimental measurement of electron particle diffusion from sawtooth-induced density-pulse propagation in the Texas Experimental Tokamak. Kim, S.K.; Brower, D.L.; Peebles, W.A.; Luhmann N.C. Jr. (Institute of Plasma and Fusion Research, University of California, Los Angeles, California 90024). *Physical Review Letters;* **60**: No. 7, 577-580(15 Feb 1988).

Electron density perturbations produced by sawtooth oscillations in the interior of the Texas Experimental Tokamak are measured with a high-resolution, multichannel, far-infrared interferometer. Abel inversion over the sawtooth perturbation indicates a space-time evolution which is diffusive in character. The diffusion coefficient is determined from a density-pulse—propagation model and found to be appreciably larger than equilibrium values.

23860 Nucleation in two-dimensional Langmuir turbulence. Russell, D.; DuBois, D.F.; Rose, H.A. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review Letters;* **60**: No. 7, 581-584(15 Feb 1988).

Simulations of the long-time behavior of the Zakharov model of Langmuir turbulence in two spatial dimensions reveal regimes where nucleation of localized electrostatic fields in previously burnt out density cavities is the mechanism which sustains the turbulence. Power spectrum diagnostics show that for moderate ion wave damping the Langmuir energy is carried by localized states.

23861 Space-potential and density fluctuations in the ISX-B tokamak. Hallock, G.A.; Wootton, A.J.; Hickok, R.L. (The University of Texas at Austin, Austin, Texas 78712). *Physical Review Letters;* **59**: No. 12, 1301-1304(21 Sep 1987).

The fluctuating plasma potential and electron density has been measured in Ohmic and neutral-beam—heated tokamak discharges. Radial profiles are presented in the outer two-thirds of the plasma, and the E x B transport calculated. The transport is found to be an order of magnitude larger for beam driven plasmas. Measurements indicate the linearized Boltzman equation is satisfied in the interior, but not at the plasma edge.

23862 Progress in ICRF heating technology and designs for future large tokamak heating systems. Baity, F.W.; Swain, D.W.; Hoffman, D.J.; Becraft, W.R.; Bryan, W.E.; Mayberry, M.J.; Owens, T.L.; Yugo, J.J. (Fusion Energy Div., Oak Ridge National Lab., P.O. Box Y, Oak Ridge, TN 37831). pp 743-750 of Fusion technology 1986. Elmsford, NY; Pergamon Books Inc. (1987). (CONF-860917—). Contract AC05-84OR21400.

From 14. SOFT - symposium on fusion technology; Avignon, France (8 Sep 1986).

The problem of advancing the technology of heating with the ion cyclotron range of frequencies (ICRF) for successful application to ignited plasmas is being addressed at Oak Ridge National Laboratory (ORNL) with the collaboration of several laboratories in the United States and Europe. The needs of experiments such as the Compact Ignition Tokamak (CIT) have been evaluated and conceptual approaches identified. These concepts and their components are examined in the laboratory and applied to present-day machines. The status of this program is presented.

23863 Progress in tokamak research. Furth, H.P. (Princeton Plasma Physics Lab., Princeton, NJ 08544). pp 2 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—). Contract AC02-76CH03073.

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

The development of powerful and flexible auxiliary plasma-heating techniques has served to advance the understanding of tokamak confinement and the achievement of reactor-relevant plasma parameters. Radiofrequency heating in various ranges (ion-cyclotron, electron-cyclotron, and lower-hybrid frequencies) is being studied at the multi-megawatt level, and neutral-beam injection has reached 20 MW. Plasma energy confinement is generally found to improve with rising tokamak current, but to deteriorate with rising heating power (tau/sub E/ ∞ IP/sup -1/2/). Very long confinement times can be obtained in the ohmic-heating regime, where P is minimal for given I; however, the fusion objectives of the tokamak call for continuing increases in the parameter V/sub H/ = P/I - from — 1 V in the ohmic-heating regime, to 5-20 V in present auxiliary-heating experiments, to > 50 V in a practical reactor.

23864 Fission-detector determination of D-D triton burn-up fraction in auxiliary-heated TFTR plasmas. Hendel, H.W.; Jassby, D.L.; Barnes, C.W.; Cecil, F.E.; Nieschmidt, E.B.; Strachan, J.D. (Princeton Plasma Physics Lab., Princeton, NJ 08544). pp 2-3 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—). Contract AC02-76CH03073.

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

By splicing signals from a system of seven /sup 235/U and /sup 238/U fission detectors with different detection efficiencies, the authors can follow the decay of neutron source strength, S, on TFTR over more than 7 orders of magnitude with good statistics. For D plasmas heated by 0.5 to 1-s D neutral-beam pulses, there is a strong initial decay of S for about 0.3 s after beam turn-off, followed by a markedly slower 2nd exponential decay that persists until current rampdown. The authors interpret this 2nd decay period to be due to the 14-MeV neutrons resulting from burn-up of the 1-MeV D-D tritons. The 2nd decay curve can be extrapolated back to the instant of beam turn-off (t-t/sub 1/) to predict the 14-MeV neutron production rate, S14, at that time. Then the estimated burn-up fraction, F/sub b/, is the ratio of S14 to the total neutron signal S at t-t/sub 1/. The F/sub b/ determined by this extrapolated-rate method is typically 0.2 to 0.8% for beam-injected TFTR plasmas at I/sub rho/ /sup -/ 1 MA.

23865 Start-up performance of the DIII-D tokamak. Callis, R.; Anderson, P.; Colleraine, A.; Davis, L.; Luxon, J.; Overskei, D.; Rock, P.; Stambaugh, R. (GA Technologies Inc., P.O. Box 85608, San Diego, CA 92138). pp 347-354 of Fusion technology 1986. Elmsford, NY; Pergamon Books Inc. (1987). (CONF-860917—).

From 14. SOFT - symposium on fusion technology; Avignon, France (8 Sep 1986).

In September 1984 the Doublet III tokamak was shut down and disassembled to allow for the implementation of the Big Dee Vessel Modification Project. The main task was to install a new dee-shaped vacuum vessel and corresponding set of outer field shaping coils that would increase the size of the plasma cross section (a = 0.67 m) and allow high elongations (b/a ≧ 2). In February 1986 the operation of DIII-D commenced. The spring and summer of 1986 has been devoted to establishing high current plasmas (up to 2.5 MA) to be used as targets for neutral beam heating which will be available in the fall. The demonstration of shaping control is well in hand with stable elongated plasmas (b/a ≧ 2) and fully developed divertor discharges being routinely produced. The ability to bake to 400°C while simultaneously performing discharge cleaning is believed to be the primary factor that has led to the rapid cleanup of the vessel and achieving flattop loop voltages as low as 1 V/turn at plasma currents of 2 MA.

23866 ECRH studies in the constance B mirror. Smatlak, D.L.; Hokin, S.A. (Plasma Fusion Center, Massachusetts Institute of Technology, Cambridge, MA 02139). pp 63 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

Experiments have been carried out to study the basic physics of electron cyclotron resonance heating (ECRH) of hot electrons in a minimum-B magnetic geometry. Up to 5 kW of microwave power at the fundamental electron cyclotron resonance frequency (10.5 GHz) is used for plasma formation and electron heating. The ECHR creates a plasma consisting typically of hot electrons (T/sub eh/=500 keV, n/sub eh/=2 x 10/sup 11/ cm/sup -3/), cold electrons (T/sub ec/=50 eV, n/sub ec/=2 x 10/sup 11/ cm/sup -3/), warm electrons, (T/sub ew/=2 KeV, n/sub ew/<10/sup 10/ cm/sup -3/), and cold ions (T/sub i/<50 eV). The effects of microwave polarization on plasma parameters has been studied by lining the vacuum chamber with microwave absorber. Good mode purity has been obtained. The reflected power is 20 dB down from the first pass microwave power levels. The plasma is illuminated with standard gain horns launching either the extraordinary or ordinary mode. Preliminary results indicate that the hot electron heating rate is similar for X and O-mode (350 keV/sec-kW), and is lower than for cavity mode heating (600 keV/sec-kW). Results from magnetic field scaling experiments are presented for the different polarizations.

23867 Plasma diagnostics: Motivations and new directions. Garscadden, A.; Ganguly, B.N. (Air Force Wright Aeronautical Labs.). pp 46 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

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Over the past twenty-five years there have been several parallel synergistic activities that had provided the impetus to plasma diagnostic developments. The first was the discovery and rediscovery of applications for discharges in gases that produce chemical reactions, thin film-depositions and plasma enhanced etching of materials. The second activity was the development of reliable laser sources, especially tunable lasers that permitted new measurement techniques for complex discharges. A third activity was the increased attention to plasmas involved in pulsed power generation and control. This lecture provides a concise update on some of the synergisms between these developments, especially the laser-based techniques for plasma measurements. The authors also venture to indicate potential directions for future research.

23868 Diagnosis of three dimensional, time varying magnetic fields in plasmas. Gekelman, W. (Dept. of Physics, Univ. of California, Los Angeles, CA 90024). pp 47 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

Measurement of the temporal evolution of magnetic field topologies in three dimensions is of great importance in a variety of problems in plasma physics. These range from the study of tearing modes, which can occur in both extraterrestrial and fusion plasmas, to the fields which surround charged particle beams or current filaments. In some cases detailed in situ measurements are not possible. For example a probe on a satellite samples data at only one position in what is believed to be a complex three dimensional situation, probes in machines with fusion parameters are rapidly destroyed (and in turn destroy confinement). In view of this a large (2 meter length, a meter diameter) plasma source has been constructed at UCLA with parameter (n/sub e/ $\simeq$ 10/sup 12//cm/sup 3/, 1 < T/sub e/ < 10 ev), (T/sub e//T/sub i/) — 10, 5 — B/sub o/ $\leq$ 150 Gauss) which allow for the insertion of probes and antennas through over 30 ports. Magnetic fields are measured with 3 orthogonal small (1 cm diameter, Δr = 1 mm) pick-up loops mounted on a probe drive capable of placing them anywhere within the device volume.

23869 Collision frequency measurements on a turbulent plasma. Spence, P.; Roth, J.R. (UTK Plasma Science Lab., Univ. of Tennessee, Knoxville, TN 37996-2100). pp 48 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

Effective collision frequencies have been measured on a turbulent plasma by electron cyclotron resonance absorbtion. The absorption measurements are interpreted in terms of numerical solutions of the Appleton equation to yield an effective collision frequency equal to the full width of the absorbtion curve at twice the resonance minimum. The scaling of this effective collision frequency to the background drift turbulence is measured and compared to an effective collision frequency due to Langmuir turbulence. Using feedback or a coherent source, a signal is applied to the plasma to directly enhance or damp the turbulent spectra. Broadening of the absorption curve is observed under turbulence enhancement. Care is taken to monitor the electron kinetic temperature in order to account for a velocity dependent collision frequency. The plasma discharge used for these studies is a uniform Penning discharge capable of electron number densities of up to a few 10/sup 10//cm/sup 3/, at electron temperatures of 10 to 100 eV. The 100 cm long discharge consists of an anode cylinder and two cathode plates. The 35 cm anode cylinder has a tungsten wire running parallel to the axis 1 cm from the inside surface. The high voltage signal for turbulence enhancement or damping is applied to the effector wire.

23870 Emission spectroscopy measurements on an ECRH non-axisymmetric mirror plasma. Junck, K.; Brake, M.; Goodman, T.; Whaley, D.; Getty, W. (Plasma Experimental Bay, Univ. of Michigan, Ann Arbor, MI 48109). pp 62-63 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

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Time resolved visible emission spectroscopy (300-700 nm) has been performed on ECr heated He, N/sub 2/, and Ar plasmas in the Michigan Mirror Machine (MIMI). The plasma is generated and heated by whistler-mode ECRH at 7.43 GHz and 500W power in 400 μs pulses. Gas is puffed into the mid-plane region where a 2.5 cm quartz window is used to observe the plasma. The plasma is viewed in a direction perpendicular to the mirror axis. Emission spectra are obtained in 100 μs sampling periods starting from the microwave turn-on time using a 0.275 meter spectrograph coupled to a gated, intensified diode array. The majority of light is found to occur from 200-300 μs from microwave turn-on time. Thermal electron temperatures are inferred from the electronic temperature of Ar and He obtained from Atomic Boltzmann plots. Electron temperature varies from 1 eV to 50 eV depending upon gas pressure, microwave power, and mirror and quadrupole field strengths.

23871 Sustained reversed field pinch discharges in OHTE with a resistive shell. LaHaye, R.J.; Bard, W.D.; Lee, P.S.; Schaffer, M.J.; Tamano, T.; Taylor, P.L. (GA Technologies Inc.). pp 65 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

RFP discharges have been made in the OHTE device whose conducting shell was changed to a 2 mm thickness of brass, characteristic time 1.5 msec, from a 15 mm thickness of aluminum, characteristic time 35 msec. RFP discharges have been sustained with reversed field for up to 14 msec in the 15 msec time constant shell device. Global plasma characteristics were very similar to those obtained with the previous long time constant shell. The equilibrium and stability of the discharge in the brass shell were studied by a variety of magnetic pickup coils inside the shell and an extensive set of 128 coils outside the shell. The 128 outside coils cover 100% of the torus in an array of 4 poloidally and 32 toroidally. The outside pickup loops exhibit a local kin instability with a growth time of about 1 msec i.e., the resistive shell time). The kink is typically one wavelength long (about 0.5 m) corresponding to n $\approx$ 16 and m

= -1. It has the same helical handedness as the magnetic field lines near the axis of the discharge. The perturbation of the plasma by this localized helical kink is analogous to that of a spring toy, a "slinky", when it is twisted.

23872 **Plasma melting and refining of metals: Current processes and diagnostic needs.** Eschenbach, R.C. (Retech, Inc.). pp 65-66 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

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When studying plasma heat for melting and refining metals, diagnostic tools differ from those used in studying plasma phenomena. This paper outlines current applications of plasma in metal melting, then the properties seen as important to these processes and, finally, some desirable improvements in measurement capabilities. Current applications for plasma metal melting can be divided into "cold-wall" and "refractory-lined" situations. In the first, the metals melted are usually one or more of: reactive, refractory, very sensitive to inclusions, or very sensitive to chemical composition. Furnaces with a separate refining hearth are used for making micro-homogeneous ingots from pure feed components, or for reducing undesired inclusions. Cold-wall plasma furnaces are also used for making rapidly solidified powders or flakes.

23873 **Particle beam probes for low temperature plasmas.** Hickok, R.L. (Rensselaer Polytechnic Institute, Troy, NY 12180-3590). pp 66 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

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Particle beam probing can provide direct spatially resolved measurements of the electron density, plasma space potential and the electron temperature. The technique was originally developed for applications to high temperature magnetically confined plasmas of interest for controlled fusion, but most of the development work was carried out on low temperature vacuum arcs. The only basic requirement is the presence of a magnetic field in order to provide spatial resolution. The procedure is to direct a beam of charged particles across the magnetic field and through the plasma. Some of the charged particles interact with the plasma electrons to form secondary ions with different charge to mass ratio. The secondary ions are then detected after they leave the plasma. Since the trajectory of the ions in the magnetic field is well known the point where the secondary ion was created can be determined with a high degree of spatial resolution.

23874 **Holographic interferometry of high pressure.** McIlwain, M.E. (Plasma Jet). pp 66 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

Measurements in turbulent flows have been historically performed using various types of probes and optical diagnostic methods. In general, probes suffer from plasma perturbation effects and are single point determination methods. Optical methods appear to be better suited to determinations in turbulent flows, however interpretation of the resulting data can often be complex. Methods such as laser Doppler anemometry, which relies on entrained particles, suffers from the fact that particles small enough to be swept along by the plasma are usually melted or sublimed in the plasma. Light refraction or diffraction methods such as shadow photography, interferometry, and holography have also been used to observe plasma flows. These methods typically suffer from the difficulty of interpreting line of sight images and obtaining quantitative data. A new method based on multi-pass holographic interferometry will be discussed. This method has certain advantages which can significantly simplify the complexity of line of sight interferometry image deconvolution. When the method employs high speed cinematography, time resolved images of the plasma flow can be obtained. This method has been applied to both transferred and non-transferred arcs and various types of DC-plasma torch produced jets. These studies and conclusions as to the usefulness of the technique are presented.

23875 **Recent advances in heavy ion beam probe fluctuation measurements techniques.** Connor, K.A.; Crowley, T.P.; Erich, S.Y.; Khan, S. (Rensselaer Polytechnic Institute, Troy, NY 12180-3590). pp 72 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

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Heavy ion beam probes have found extensive application in the measurement of plasma electron density and potential fluctuations. Diagnostic systems on the TEXT, ISX, and RENTOR tokamaks have demonstrated that frequency and wave number spectra can be obtained for fluctuations with frequencies up to a MHz. Measurements thus far have been limited in a number of ways. Simultaneous measurements at up to three nearby spatial locations has permitted the wave number component in only one direction to be determined. The size and distance between sample volumes determines the smallest wave length that can be resolved. Short wave length phenomena also are manifested as sources of error as more information is being extracted from signal than ever before. A variety of new approaches to beam probe hardware and software are being investigated that should make it possible to more completely realize the potential for fluctuation measurements. The position of the measurement location in the plasma is determined by the magnetic field, the momentum (i.e., mass energy and direction) of the probing ion and the location of the detector. The present three nearby measurements are obtained by having a three aperture detector with three sets of current collection plates.

23876 **Heavy ion beam probes for stellarators.** Aceto, S.C.; Carnevali, A.; Connor, K.A.; Lewis, J.F. (Rensselaer Polytechnic Institute, Troy, NY 12180-3590). pp 72-73 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

A heavy ion beam probe is being designed for the ATF torsatron at Oak Ridge National Laboratory. Beam probes are also either being designed or under consideration for stellarator type devices in Japan and the Soviet Union. The primary purpose for this diagnostic on a stellarator is direct determination of the plasma potential structure which is largely responsible for the particle drift surfaces in a nonaxisymmetric toroidal confinement device. Beam probes have been successfully implemented on tokamaks and bumpy tori but the complex magnetic geometry of a stellarator presents some significant difficulties not encountered before. The helical field coils make it impossible to locate the input and output ports used by the beam probe in the same toroidal plane. They are separated by 15 degrees on ATF. There are also substantial return fields in the region of the beam line optics and the electrostatic energy analyzer electric fields. The separation of the ports and the open field structure produces a large dispersion in ion trajectories. The design for the ATF system has successfully addressed these problems.

23877 **Fluctuation studies of the edge plasma on the RENTOR tokamak.** Santoro, R.A.; Hickok, R.L. (Rensselaer Polytechnic Institute, Troy, NY 12180-3590). pp 73 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

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Two Langmuir probes with a separation of 0.540 cm were used to measure poloidal and toroidal potential and density fluctuations in the 0-200 kHz range in the edge region of the Rensselaer Polytechnic Institute research tokamak RENTOR. RENTOR is a small device of major radius 45 cm, minor radius 15 cm, toroidal magnetic field 3.5 kG, typical pulse length 10 msec, loop voltage 5V, peak plasma current 20 kA, peak electron density → 10/sup 12/ cm/sup -3/ and peak electron temperature 0.1 keV. Quantities of particular interest such as n/sup —//n, PHI/sup —// PHI, ePHI/sup —//k/sub b/T and [ePHI/sup —//κ/sub b/T]/[n/sup —//n], were examined as a function of radius for both poloidal and toroidal fluctuations. The phase, coherence, autopower, and κ(w)

spectra were determined for the poloidal, toroidal, and radial directions and an estimate of the outward-induced particle transport in the edge region was made. These results will be compared with similar measurements made with the heavy ion beam probe.

23878 The use of secondary emissive capacitive probes to determine plasma potential: A new diagnostic technique. Hershkowitz, N.; Wang, E.Y.; Diebold, D.; Intrator, T.; Majeski, R.; Persing, H.; Severn, G.; Nelson, B.; Wen, Y.J. (Dept. of Nuclear Engineering and Engineering Physics, Univ. of Wisconsin-Madison). pp 73 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

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The authors developed a new plasma potential diagnostic technique that is suitable for use in plasmas in which the electron temperature T/sub e/ is greater than 40 → 50 eV. The technique is based on secondary electron emission by plasma electrons. When T/sub e/ ≧ 40 eV, the secondary electron emission coefficient (defined as the ratio of emitted to collected electron current) is greater than 1.0. Under such circumstances it is shown that the floating potential of a glass probe inserted into a plasma with plasma potential V/sub rho/ is given by V/sub f/ = V/sub rho/ - (0.7 +- 0.2) T/sub e//e. The authors took advantage of this result to construct a secondary emission capacitive probe (SECP) of the plasma potential. This probe is much less sensitive to electron temperature variations than conventional nonemitting floating probes which differ from the plasma potential by 3.5 T/sub e//e in a hydrogen plasma. The probe consists of a glass envelope and a detecting electrode. The coupling capacitance to the plasma was measured to be 0.3 → 0.6 pf. Details of the probe construction are presented.

23879 Vacuum and sheath potential measurements with current biased emissive probes. Diebold, D.; Bailey, A.; Intrator, T.; Hershkowitz, N. (Nuclear Engineering and Engineering Physics Dept., Univ. of Wisconsin-Madison). pp 73-74 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

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Data are presented which show that an electron emitting ("emissive") probe with proper current bias can make accurate vacuum potential measurements. Data show that a probe which is current biased to make accurate vacuum potential measurements also makes accurate sheath potential measurements. The accuracy and time response of this "current bias method" is compared with the accuracy and time response of two other emissive probe techniques, the inflection point in the limit of zero emission technique and the floating potential of a strongly heated probe technique. In a vacuum, finite current biased emissive probes are shown to be more accurate and have better time response than zero current biased (floating) emissive probes. The measurements were made in DOLI I, a triple plasma device (length 0.5 m, radius 0.25 m). Base pressure was 5 x 10/sup -6/ torr. For the sheath potential measurements, the plasma density was approximately 10/sup 8/ cm/sup -3/, T ≅ 1 - 2eV and the operating Argon pressure was 5 x 10/sup -5/ torr. The proper current bias for accurate vacuum potential measurements was determined in an empty, grounded vacuum chamber. The proper current bias for any particular probe was determined by strongly heating the probe and then varying its current bias until its voltage was ground.

23880 An in-situ spectroscopic erosion yield measurement of material erosion and redeposition in plasma. Leung, W.K.; Hirooka, Y.; Conn, R.W.; Goebel, D.M.; Labombard, B. (Univ. of California, Los Angeles). pp 74 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

Use of the line radiation of material eroded by plasma bombardment is investigated as an in-situ erosion yield measurement in the PISCES plasma facility. PISCES produces plasma with parameters which are similar to those of the edge-plasma of fusion devices. The experiments are done with material sample of 2.5 cm in diameter held in the center of the 10 cm diameter circular plasma. The typical magnetic field is 250 gauss. A Langmuir probe is inserted in front of the material sample to measure electron temperature and density from time to time during the experiments. The typical electron temperature ranges from 4 eV to 20 eV. The plasma density can be varied from 10/sup 11/ to 10/sup 13/ cm/sup -3/. The incident plasma flux on the material sample ranges from 10/sup 17/ to 10/sup 18/ ion cm/sup -2/s/sup -1/. The bombarding ion energy is set by the electrical bias of the sample with respect to the plasma. A 1.33 m Czerny-Turner monochromator is used to view the plasma in front of the sample perpendicular to the direction of the magnetic field. The line radiation from the eroded material sample in the plasma is found to follow the materials erosion behavior. An example is shown in Fig. 1. In this case, the material is copper while the background plasma is argon. The measured electron temperature and density are 8.5 eV and 1.4x10/sup 12/ cm/sup -3/ respectively. The normalized intensity of the CuI (3247.5 A) line in the plasma column is plotted against the measured erosion yield at different ion bombarding energies. The normalized line intensity shows a linear relation with the erosion yield as independently evaluated by the weight loss method. It follows that this method allows us to quantitatively monitor in-situ the erosion yield with proper calibration.

23881 Far-infrared interferometry and scattering measurements on the TEXT tokamak. Brower, D.L.; Kim, S.K.; Peebles, W.A.; Luhmann, N.C. (Institute for Plasma Physics and Fusion Engineering, and Dept. of Electrical Engineering, Univ. of California, Los Angeles, Los Angeles, CA 90024). pp 76 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

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A 20 channel far-infrared (γ = 432 μm) heterodyne interferometer is used to measure in detail) the density profile and associated MHD activities in TEXT. The system possesses high spatial (Δchi ≅ 1.5 cm) and phase resolution. Time evolution of the density during start-up is presented together with profile variation with various discharge parameters. For instance, a hollow n/sub e/ profile is seen during start-up which eventually evolves into a centrally peaked n/sub e/(r) distribution. The q-scaling of n/sub e/(r) is also clearly observed with high-q profiles characterized by a relatively narrow central peak as compared to the low-q discharges where the density profile was flat at the center. This scaling is observed with changes to I/sub rho / or B/sub T/. In addition, the density profile broadens with increasing n/sub e/. Discharges modified by oscillating gas puffs, ECRH, and pellet injection are also being investigated. Interferometric measurement of density sawteeth and double (giant) sawteeth plus the associated internal density Mirnov oscillations are presented. The observed mode on a double sawtooth is m=1, the same as the standard sawtooth phenomena. The high resolution (spatial and phase) of the multichannel interferometer permits inversion of the line-averaged sawtooth allowing density pulse propagation experiments to be realized for the first time. The inferred diffusion coefficient, outside the mixing radius, is 4-7 times larger than that measured in equilibrium.

23882 Tomographic reconstruction of density contours in the Microtor tokamak. Howard, J.; Doyle, E.J.; Peebles, W.A.; Luhmann, N.C.; Gull, S.F. (Univ. of California, Los Angeles, CA 90024). pp 76-77 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

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Conventional interferometer systems employed on fusion devices are typically limited to approximately ten chordal channels in a given cross section and so provide limited information about the two dimensional distribution of electron density in the device. Strong a priori constraints must usually be imposed in order to recover the density "profile". The authors report here the successful operation of a two dimensional, forty channel, phase imaging interferometer installed to obtain the 2-D density distribution in the po-

loidal cross section of the UCLA Microtor tokamak. This enhanced capability, for the first time, allows extraction of unambiguous information about the plasma distribution which in no way depends on a priori knowledge.

23883 **Spatial and temporal variations of a sodium fluoride capillary discharge plasma.** Welch, B.L.; Griem, H.R.; Commisso, R.J.; Young, F.C. (Naval Research Lab., Washington, DC 20375). pp 70 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

A capillary discharge plasma has been developed and fielded on the Gamble II pulsed power generator for producing an intense source of the He-like sodium resonance line for matched line photopumping of He-like neon. The sodium implosions have produced up to 25 GW of power from the 1.13 keV line of interest. Since the implosion dynamics depend on the linear mass density of the z-pinch, further investigation of the sodium source has been carried out to determine the axial and radial variations of the source. The plasma was produced by discharging a 1.8 μf capacitor bank charged to 25 kV through a 0.021 inch diameter capillary drilled in packed sodium fluoride powder. The powder was heat by the electrical discharge and subsequently ejected from the capillary into an anodized aluminum nozzle which restricted expansion of the plasma and directed it into a cylindrical column. A peak current of about 50 kA was delivered to the capillary in about 1 μs.

23884 **Potential formation and stabilization by RF in the Tara tandem mirror.** Golovato, S.N.; Brau, K.; Casey, J.; Coleman, J.; Guss, W.; Hallock, G.; Horne, S.; Irby, J.; Kesner, J.; Kumazawa, R. (Plasma Fusion Center, Massachusetts Institute of Technology, Cambridge, MA 02139). pp 63-64 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

The Tara tandem mirror is run in an effectively axisymmetric configuration by not producing β in the quadrupole anchor cells. Plasma production and heating in the central cell is provided by slow waves excited by a slot antenna located on a midplane bump in the magnetic field. Ion cyclotron resonances are at the minimum central cell fields on either side of the bump. Fast wave excitation by double-half-turn antennas at the minimum field can also be used. Stable plasmas are produced by either antenna but higher β per kW is achieved with slow wave excitation. An m=1 flute mode which has been observed to be unstable in Tara is stabilized by a combination of a magnetic divertor at the central cell midplane and slow wave excitation. The mode may be driven unstable by build up of plasma in the axisymmetric plug cells on each end of the central cell. It is stabilized by increasing the slot power and/or moving the null point of the divertor deeper into the plasma. The stabilizing effect of the RF is presumed to be due to the ponderomotive force. Both ICRF and ECHR are used in the plug cells to produce ion confining potentials to reduce end loss. The ICRF is launched by a slow wave antenna on one end and a fast wave antenna on the other. Both configurations produce end plugging, allowing an overall improvement in central cell confinement. ECRH has also produced end plugging when sufficient slot power is applied to maintain stability. Increase in central cell density is observed up to more than 4 x 10/sup 12/ cm/sup -3/. The efficiency of each technique for potential production will be discussed.

23885 **Mode control with phased antenna arrays in the Phaedrus-B tandem mirror.** Browning, J.J.; Majeski, R.; Yasaka, Y.; Hershkowitz, N.; Roberts, D. (Dept. of Nuclear Engineering and Engineering Physics, Univ. of Wisconsin-Madison). pp 64 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

Two phased ICRF antenna configurations have been studied in the central cell of the Phaedrus-B tandem mirror. In the first configuration, a pair of dual half-turn ICRF antennas spaced d = 1 m apart or driven with variable relative phase. Separate amplifiers, each with < 200 KW power output, are used to drive the antennas, so that the relative phase may be fixed or swept during a shot as desired. The power in the antenna κ/sub 11/ spectrum near κ/sub 11/ = (neta/d) is a strong function of the relative antenna phasing. As a result, excitation of the m = +1 fast magnetosonic wave (which has κ/sub 11/ — 0.03 cm/sup -1/ for typical Phaedrus plasma parameters) can be controlled by varying the relative phase of the antenna currents. In the second configuration, a pair of dual half-turn ICRF antennas spaced 7.5 cm apart are driven with variable relative phase in a "rotating field" arrangement. The symmetry axes of the antennas are rotated 90° with respect to each other. Depending on the relative phase of the antenna currents, the resultant fields can be left circularly polarized, right circularly polarized, or linearly polarized. Ion heating efficiency and slow magnetosonic wave excitation have been investigated as a function of the relative antenna phasing for this configuration.

23886 **Tokamak as an x-ray/XUV light source.** Lee, P. (GA Technologies Inc., P.O. Box 85608, San Diego, CA 92138). pp 238-243 of X-ray calibration: Techniques, sources and detectors. Rockett, P.D.; Lee, P. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1986). (CONF-860880—).

From 30. SPIE technical symposium on optics and optoelectronic engineering; San Diego, CA, USA (17 Aug 1986).

Modern large tokamak devices, with electron and ion temperatures in the range of 1 to 10 keV, plasma densities of 1 to 10x10/sup 13/ cm/sup -3/, and quasistationary discharges of 1 to 10 s, emit copious amounts of soft x-ray and XUV radiation. Furthermore, plasma parameters such as temperatures, density, power input, and radiative power are usually well-characterized, making tokamak discharges extremely useful in experimental atomic physics and, to a lesser extent, instrumentation calibration.

23887 **Los Alamos x-ray characterization facilities for plasma diagnostics.** Day, R.H.; Blake, R.L.; Stradling, G.L.; Trela, W.J.; Bartlett, R.J. (Physics Div., Los Alamos National Lab., P.O. Box 1663, Mail Stop D410, Los Alamos, NM 87545). pp 208-217 of X-ray calibration: Techniques, sources and detectors. Rockett, P.D.; Lee, P. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1986). (CONF-860880—).

From 30. SPIE technical symposium on optics and optoelectronic engineering; San Diego, CA, USA (17 Aug 1986).

A summary is given of characteristics of x-ray sources used by Los Alamos National Laboratory to calibrate various x-ray diagnostic packages and components. Included are D.C. sources in electron impact and fluorescence modes, a pulsed laser source for soft x rays with 100 ps time resolution, Febetron pulsed electron impact sources, and both EUV and x-ray synchrotron beamlines.

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REFER ALSO TO CITATION(S) 21083, 22258, 22302, 22374, 22402, 22411, 22413, 22419, 23830, 23863, 23865

23888 **(AD-A—187420/5/XAB) Fusion, and advanced-fuel, reaction bibliography. Particle reactions from H1 to B11. Special report, 17 February-17 August 1987.** Pass, H.H. (Air Force Avionics Lab., Wright-Patterson AFB, OH (USA)). Aug 1987. 31p. (AFAL-TR—87-073). NTIS, PC A03/MF A01.

The Air Force Astronautics Laboratory has an ongoing program of studying the feasibility of fusion powered propulsion. This study first examines nuclear fuels and their associated fuel cycles. The investigated fuels and fuel cycles will then be used to explore present and proposed fusion propulsion concepts. From this study, it will be determined which concepts, if any, will be able to produce fusion propulsion systems using present or near term technology. The objective of the work reported herein was to compile a comprehensive list of the experimentally measured nuclear reactions involving the nuclides up to and including B11 (Boron-11). This compilation was performed in order to identify any new fuels

and/or fuel cycles that would be potential candidate to replace the presently utilized fuels deuterium and tritium. Also, the project is intended to provide a readily accessible source of information for individuals who are studying fuels, reactions, and fuel cycles.

23889 **(CEA-CONF—9173) Polyimide-alumina: a performant insulator used in a superconducting magnet cooled with superfluid helium.** Libeyre, M. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France). Dept. de Recherches sur la Fusion Controlee). Mar 1987. 12p. (In French). (CONF-8703241—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88752141/JAW.

From Materials meeting; Compiegne, France (12 Mar 1987).

Thermal insulation between the coils of the toroidal magnet of Tore Supra and the "box" including it able to transmit mechanical efforts is necessary. To require to the specifications a new material has been developed; industrial production of this material has also been realized.

23890 **(CONF-880155—2-Vugraphs) ITER poloidal magnetics.** Strickler, D.J.; Peng, Y.K.M.; Sayer, R.O. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 10p. NTIS, PC A02. Order Number DE88006178/JAW.

From US-ITER physics meeting; Dallas, TX, USA (6 Jan 1988).

This paper discusses the design issues, the design codes and near term plans for ITER tokamak poloidal field divertors. (LSP)

23891 **(EGG-M—32287) Economic comparison of fusion fuel cycles.** Brereton, S.J.; Kazimi, M.S. (EG and G Idaho, Inc., Idaho Falls (USA); Massachusetts Inst. of Tech., Cambridge (USA)). 1987. Contract AC07-76ID01570. 5p. (CONF-871007—85). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005634/JAW.

From 12. symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

The economics of the DT, DD, and DHe fusion fuel cycles are evaluated by comparison on a consistent basis. The designs for the comparison employ HT-9 structure and helium coolant; liquid lithium is used as the tritium breeding material for the DT fuel cycle. The reactors are pulsed, superconducting tokamaks, producing 1200 MW of electric power. The DT and DD designs scan a range of values of plasma beta, assuming first stability scaling laws. The results indicate that on a purely economic basis, the DT fuel cycle is superior to both of the advanced fuel cycles. Geometric factors, materials limitations, and plasma beta were seen to have an impact on the Cost of Electricity (COE). The economics for the DD fuel cycle are more strongly affected by these parameters than is the DT fuel cycle. Fuel costs are a major factor in determining the COE for the DHe fuel cycle. Based on costs directly attributable to the fuel cycle, the DT fuel cycle appears most attractive. Technological advances, improved understanding of physics, or strides in advanced energy conversion schemes may result in altering the economic ranking of the fuel cycles indicated here. 7 refs., 6 figs., 2 tabs.

23892 **(GA-A—19081-Del.) Compact ignition tokamak first wall/divertor tile and attachment R and D: FY-87, Final report.** Hurn, T.; Sevier, L.; Gallix, R.; Baxi, C.; Patel, P.; Puhn, F.; Watson, R.; Croessman, C.; Watkins, J.; Dempsey, F. (GA Technologies, Inc., San Diego, CA (USA)). Dec 1987. Contract AC03-84ER53158. 134p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88006161/JAW.

The CIT first wall protective tile and attachment development program covers a 3-yr period (October 1, 1986 to September 30, 1989). This report describes the tasks performed by GA, Sandia National Laboratory Albuquerque (SNLA) and TRW during the first year of this R and D program. The tasks were to: (1) select candidate materials for the tiles; (2) test these materials; (3) fabricate full-scale test tiles and attachments; (4) study their resistance to thermal and mechanical loads; and (5) investigate their cooling performance. In addition, an investigation into the suitability of carbon-carbon composites for a large "panel-like" tile was initiated at midyear. 9 refs., 11 tabs.

23893 **(GA-A—19113) Compact Ignition Tokamak (CIT) vacuum vessel welded joint R and D: FY-87 final report.** Hurn, T.; Kaae, J.; Gallix, R.; Puhn, F. (GA Technologies, Inc., San Diego, CA (USA)). Jan 1988. Contract AC03-84ER53158. 196p. NTIS, PC A09/MF A01; 1; GPO Dep. Order Number DE88006306/JAW.

The general purpose of the vacuum vessel welded joint research and development program for FY-87 was to begin the development of both an optimum welded joint design and an analytical method for predicting joint distortion. This work was divided into three subtasks: weld joint tests, to develop automatic welding parameters and producing reliably strong, low distortion joints; material tests, to assess the long term reliability of the welded joints by means of metallographic examinations and fatigue tests; and weld joint analysis, to develop a reliable general method to analytically predict weld joint distortion. 2 refs., 8 figs.

23894 **(IAE—4344/8) Computer code for calculation of spatial-energy distribution of neutrons in one-dimensional geometry (BLAN26).** Zimin, S.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1986. 36p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701029/JAW.

A new version of the BLANK computer code, developed for calculating a neutron spectrum in one-dimensional geometry problems, with an external source and estimating energy release in the neutron high energy region (E/sub n/ > 0.1 MeV), called BLAN26, is described. In this version the multi-group constants used in the POLINA section are prepared by the MARS routine. The BNAB-78 26-group system constants is used. Using the BLAN26 computer code two types of thermonuclear reactor blankets - fast and intermediate - have been calculated. The results of these calculations are compared to the similar ones obtained by the BLANK with the 21-group nuclear data library. 6 refs.; 6 figs.; 13 tabs.

23895 (INIS-SU—441, pp 29-34) **Mass transfer and selective sputtering of structural materials by low-energy ions in plasma-surface interaction. Theory.** Drichko, D.A.; Dunaev, V.V.; Zhiglinskij, A.G.; Kuchinskij, V.V.; Pleshivtsev, N.V.; Semashko, N.N.; Sukhomlinov, V.S.; Fafurina, Eh.N.; Shejkin, E.G. 1987. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88780051/JAW.

Voprosy Atomnoj Nauki i Tekhniki.; no. 1.

In Thermonuclear synthesis.

The advantages of a method of hollow-cathode discharge for modelling sputtering of the first wall of a fusion reactor, are discussed. The results of the theory of sputtered atom motion to a probe in the diffusion mode and formulae for calculation of the fracture of cathode-sputtered atoms arriving on the probe are presented. The relations are given for determination of the selective coefficients of sputtering of material components and their concentration in spectral-probe investigation.

23896 (INIS-SU—441, pp 23-29) **On a possibility of enrichment of fission reactor fuel elements in a fusion reactor blanket.** Polikhovskaya, N.E.; Shatalov, G.E. 1987. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88780051/JAW.

Voprosy Atomnoj Nauki i Tekhniki.; no. 1.

In Thermonuclear synthesis.

Energetic system, composed of hybrid thermonuclear reactor (HTR) and several WWER is considered. Fuel elements of debleted uranium or thorium are enriched in the blanket of thermonuclear reactor. After fissile isotopes (Pu or /sup 233/U) reach the necessary concentration, these elements are transported into WWER core without additional treatment where they are burnt to complete service life. The depth of natural uranium burming can be brought to 50-70 MW x day/kg, which is ~ 10 times higher as compared to one in up-to-date nuclear power engineering using thermal reactors. Optimization of HTR blanket contents was conducted for maximal enrichment of fuel elements. The minimal burnup and the maximal enrichment rate were achieved in the blanket, where the zone of fuel elements is separated from plasma by lead breeding shield. Introduction of lithium moderator enables to

reduce fuel element amount in enrichment zone and increase respectivey their enrichment rate.

23897 (INIS-SU—441, pp 42-46) **Application of switches based on the electron-beam rectifier in the power supply system of the OGRA-4 ion sources.** Gubin, L.A.; Kuklinskij, B.D.; Kucheryaev, Yu.A.; Lipatov, V.S.; Matveev, N.V.; Naguchev, O.Yu.; Obysov, V.A.; Perevodchikov, V.I.; Shapenko, V.N. 1987. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88780051/JAW.

Voprosy Atomnoj Nauki i Tekhniki.; no. 1.
In Thermonuclear synthesis.

Consideration is being given to the switch based on the electron-beam rectifier and its control system, enabling to switch voltage on ionic source with high efficiency. VAELK 50/50 switch is composed of control board, isolation transformer unit, control device and electron-beam AELV 50/100 rectifier. The control system provides for the possibility of load protection from breakdowns and its reswitching after electric strength recovery. Results of four switches operation in power supply system of the Ogra-4 ion sources are presented.

23898 (INIS-SU—441, pp 47-50) **Magnetic self insulation of transmission lines with a nanosecond circuit breaker.** Gordeev, A.V.; Zazhivikhin, V.V. 1987. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88780051/JAW.

Voprosy Atomnoj Nauki i Tekhniki.; no. 1.
In Thermonuclear synthesis.

The paper deals with application of plasma erosion switches for peaking power of pulse generators. Basic characteristics of magnetic selfinsulation waves which propagate in vacuum transmission line after operation of plasma erosion switch. It is shown that consideration of electron flow results in the decrease of voltage pulse amplitude by 20% as compared to the vacuum case. The influence of finiteness of switch time on pulse magnitude is considered.

23899 (INIS-SU—441, pp 50-56) **Problems of high efficient energy transfer from inductive storage to inductive load.** Druzhinin, A.S.; Kuchinskij, V.G.; Larionov, B.A.; Stolov, A.M.; Suslov, V.A.; Lototskij, A.P.; Yagnov, V.A. 1987. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88780051/JAW.

Voprosy Atomnoj Nauki i Tekhniki.; no. 1.
In Thermonuclear synthesis.

Increase of efficiency of inductive storage (IS) energy transfer to inductive load represents one of important problems arising when designing pulse feed systems on the base of IS. Earlier suggested circuits were analyzed and general conditions of highly efficient transfer of magnetic energy were formulated. The stepwise IS energy transfer with minimization of the relative value of commulated current at every stage is the main condition. For this purpose it is necessary to change the ratio between IS inductions and the lood. The expression for efficiency in the form of eta ~ 1 - const/N, where N-the number of stages of energy transfer, was obtained for a wide range of circuits with slightly dissipative energy transfer. Advantages and drawbacks of certain circuits were discussed.

23900 (INIS-SU—441, pp 56-59) **Numerical simulation of fast charged particle dynamics in a dense gas of an injector intended for CTF.** Afanas'ev, P.N.; Svistunov, Yu.A.; Sidorov, V.P.; Udovichenko, S.Yu.; Chkuaseli, D.V. 1987. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88780051/JAW.

Voprosy Atomnoj Nauki i Tekhniki.; no. 1.
In Thermonuclear synthesis.

Motion of ion beams in a dense gas is considered. Fast particle dynamics in electric field of plasma, created in result of inelastic processes with recombination excluded was studied using numerical simulation. It is shown that formation of "plasma lense" with stationary ambipolar electric field which can affect sufficiently the transverse beam dynamics, takes place in chamber with a dense gas along with formation of fast neutral particles. Ambipolar field intensity grows with increase of gas density and plasma density respectively. This results to a more intensive drift of slow positive plasma ions to the periphery and fast negative particles - to the beam axis.

23901 **(INIS-SU—441) Thermonuclear synthesis.** (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow). 1987. 68p. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88780051/JAW.

Voprosy Atomnoj Nauki i Teknniki.; no. 1.
Individual papers have been indexed separately. (WRF)

23902 **(IPP—1/243) ASDEX Upgrade assembly track.** Ennen, K.; Lackner, E.; Reese, W.H. (Noell G.m.b.H., Wuerzburg (Germany, F.R.)). (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.); Noell G.m.b.H., Wuerzburg (Germany, F.R.)). Jun 1987. 28p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number TI88752481/JAW.

The torus of ASDEX Upgrade consists of 8 identical segments ('octants'), which are prefabricated by a special device ('prefabrication stage') and are then assembled later at the place for assembly. An octant consists of one eighth of the vacuum vessel, one eighth (consisting of 4 castings) of the tilting structure and 2 TF coils. After the first measuring work at the place for assembly, the foundations of the TF system are mounted. A spindle lifting device is fitted to these foundations, on which the lower spoked wheel of the PF system is built up in the lowered position. A 16 metre long assembly track is erected above the spoked wheel, on which the torus or parts of it can be moved. Because of the inner stabilising coils (PLS and CoI), it is not possible to build up the torus completely in one operation. Instead, the two halves of the torus are built up separately, so that the halves of the coils can be rotated in. Only then can the two halves of the torus be brought together and connected. The complete torus then has to be moved again, in order to be able to mount the lower annular coils (OHZ, V1, V2, CoA and V3).

23903 **(ITEF—26(1987)) Neutralization of an intense bunch of heavy ions when focusing onto a thermonuclear target.** Zenkevich, P.R.; Korolev, A.P. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 15p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701110/JAW.

Effect of ionization of a residual gas in a reactor chamber at 10/sup -4/ mm Hg pressure ≦ p ≦ 10/sup -3/ mm Hg on dynamics of a bunch of heavy ions, being focused onto a thermonuclear target has been investigated. Particle separation generated at gas ionization into three fractions (slow ions, fast and slow electrons) has been taken into account. A set of equations determining beam cross section and relative number of particles in fractions has been obtained for the bunch with uniform density of particles. Numerical calculations have shown that beam neutralization in a medium vacuum is a perspective method for reducing the Coulomb forces. 11 refs.; 3 figs.

23904 **(ITEF—129(1987)) On selfsimilar thermonuclear ignition of a plasma in necks of zeta devices.** Neudachin, V.V.; Sasorov, P.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 16p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701640/JAW.

A problem of thermonuclear ignition of a plasma in necks of zeta devices is considered. It is shown that in the power initial distribution of DT mixture density both in the framework of hydrodynamics and kinetic Boltzman-Vlasov equations, the thermonuclear ignition distribution can be of a selfsimilar character. The problem with spherically symmetric initial density distribution is investigated in detail in the framework of ideal hydrodynamics with local α-particle energy release. Critical value rhor found in this case is turned out to be equal to 0.25 g/cm/sup 2/. Prolonged ignition distribution is impossible at less rho. 6 refs.; 3 figs.

23905 (JAERI-M—86-143) Suppression of the metal impurity release during ICRF heating by the installation of carbon block. Tamai, H.; Ogawa, H.; Ogawa, T.; Matsumoto, H.; Odajima, K. (Japan Atomic Energy Research Inst., Tokyo). Oct 1986. 16p. (In Japanese). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87702953/JAW.

The radiation loss during ICRF heating is reduced by the installation of carbon block around the antenna in JFT-2M Tokamak. The reduction is resulted from the suppression of metal impurity release such as titanium and iron especially around the ICRF antenna. This result intensively supports the theoretical prediction that the electric field near the antenna plays the dominant role to induce the metal impurity release during ICRF heating.

23906 (JAERI-M—86-176) Analyses and experiments on the integrity and lifetime predictions of plasma-facing components in fusion reactors. Tone, T.; Seki, M.; Minato, A. (Japan Atomic Energy Research Inst., Tokyo). Jan 1987. 310p. (In Japanese). NTIS (US Sales Only), PC A14/MF A01. Order Number DE87702957/JAW.

Analyses and experiments on the integrity evaluation and lifetime predictions of plasma-facing components in fusion reactors such as first walls, divertor plates and pumped-limiter plates have been performed. Results of the following issues have been obtained. (1) Examination of life-limiting factors based on One-dimensional calculations; (2) Plastic deformation impact based on two-dimensional elastic-plastic analysis; (3) Sputtering and redeposition analysis; (4) Thermo-mechanical analysis of the first wall subjected to one-sided heating; (5) Melting and evaporation experiments of solid walls subjected to intense heating; (6) Melt layer stability; (7) Thermal fatigue tests of tungsten-copper duplex structures for divertor plates; (8) Torsional fatigue tests of tungsten-copper butt joints; (9) Analysis of eddy current and dynamic electromagnetic force; (10) Experiments on the dynamic deformation of ferritic and non-ferritic metal caused by electromagnetic force.

23907 (JAERI-M—87-005) Development of bucket ion source for JFT-2M neutral beam injector. Shibata, T.; Kazawa, M.; Yokoyama, K.; Shibuya, T.; Honda, A.; Shiina, T. (Japan Atomic Energy Research Inst., Tokyo). Feb 1987. 29p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE87702961/JAW.

Detailed description is given of a new Bucket Ion Source for NBI heating experiments on JFT-2M. The source is designed to achieve the high proton ratio (— 80 %) as well as high power. Results of the performance test is also given.

23908 (JAERI-M—87-013) Investigation of a Nb-Ti cable-in-conduit conductor: experimental results. Phelan, P.E. (Japan Atomic Energy Research Inst., Tokyo). Feb 1987. 38p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE87702964/JAW.

A NbTi, Cable-in-conduit sample coil was experimentally investigated by using inductive heat inputs of durations 0.44 and 2.1 msec. Since the original goal of determining the effect of varying conductor perimeter on stability could not be achieved, the stability parameters which were studied and reported include mass flow rate, heating duration, and the presence of liquid helium outside of the conduit versus a surrounding vacuum. In addition, quench-induced pressure rises, both at zero and non-zero imposed flow rates, were measured. Results indicate that stability increases with imposed mass flow, stability increases with heating duration before the limiting current, and helium outside of the conduit has no discernible effect on transient stability. A detailed analysis of these findings will be published in the future.

23909 (LA—11110) Analysis of tritium production in concentric spheres of oralloy and ^{6}LiD irradiated by 14-MeV neutrons. Fawcett, L.R. Jr.; Roberts, R.R. II; Hunter, R.E. (Los Alamos National Lab., NM (USA)). Mar 1988. Contract W-7405-ENG-36. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006308/JAW.

Tritium production and activation of radiochemical detector foils in a sphere of ^{6}LiD with an oralloy core irradiated by a central source of 14-MeV neutrons have been calculated and compared with experimental measurements. The experimental assembly consisted of an oralloy sphere surrounded by three solid ^{6}LiD concentric shells with ampules of ^{6}LiH and ^{7}LiH and activation foils located in several positions throughout the assembly. The Los Alamos Monte Carlo Neutron Photon Transport Code (MCNP) was used to calculate neutron transport throughout the system, tritium production in the ampules, and foil activation. The overall experimentally observed-to-calculated ratios of tritium production were 0.996 +- 2.5% in ^{6}Li ampules and 0.903 +- 5.2% in ^{7}Li ampules. Observed-to-calculated ratios for foil activation are also presented. 11 refs., 4 figs., 7 tabs.

23910 (LBL—23112) Challenges of nuclear fusion. Kunkel, W.B. (Lawrence Berkeley Lab., CA (USA)). May 1987. Contract AC03-76SF00098. 9p. (CONF-870503—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88006338/JAW.

From World conference on advanced materials needed for innovations: energy, transportation and communications; Tokyo, Japan (17 May 1987).

After 30 years of research and development in many countries, the magnetic confinement fusion experiments finally seem to be getting close to the original first goal: the point of "scientific break-even." Plans are being made for a generation of experiments and tests with actual controlled thermonuclear fusion conditions. Therefore, engineers and material scientists are hard at work to develop the required technology. In this paper the principal elements of a generic fusion reactor are described briefly to introduce the reader to the nature of the problems at hand. The main portion of the presentation summarizes the recent advances made in this field and discusses the major issues that still need to be addressed in regard to materials and technology for fusion power. Specific examples are the problems of the first wall and other components that come into direct contact with the plasma, where both lifetime and plasma contamination are matters of concern. Equally challenging are the demands on structural materials and on the magnetic-field coils, particularly in connection with the neutron-radiation environment of fusion reactors. Finally, the role of ceramics must be considered, both for insulators and for fuel breeding purposes. It is evident that we still have a formidable task before us, but at this point none of the problems seem to be insoluble. 17 refs., 3 figs.

23911 (NIIEFA-P-B—0741) KOMPOT program complex for the calculation of spatial magnetostatic fields of electromagnetic systems. Dojnikov, N.I.; Lamzin, E.A.; Simakov, A.S.; Sychevskij, S.E. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)). 1986. 13p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701691/JAW.

A program complex for calculating spatial magnetic fields of electrophysical plant electromagnetic systems is described. The complex is realized in algorithmic FORTRAN language. The methods are based on applying a modified scalar potential with an additional vector, determined in local subarea of the calculated area. Digitization of differential equations is performed using the finite element method. 18 refs.

23912 (PB—88-130893/XAB) Time-resolved x-ray emission from laser-produced plasmas with timing fiducial. Lampart, W.; Balmer, J.E. (Bern Univ. (Switzerland). Inst. fuer Angewandte Physik). 5 May 1986. 14p. (MM—1985/86-BAL-7). NTIS, PC E03/MF A01.

High-temperature plasmas were produced by focusing 1.05-microm, 100-psec laser pulses onto Al layer targets at a mean irradiation of 3 x 10^{13} Watt/sq cm. By means of simultaneous measurements of the thermal x-ray emission and the frequency-quadrupled laser pulse the authors observe a 20 plus or minus 15 psec delay of the X-ray peak relative to the peak of the incident laser pulse. In addition, modulations on the trailing edge of the driving pulse appear strongly enhanced in the x-ray signature.

23913 **(PNL-SA—15197) The irradiation of solid breeder pellets, spheres and single crystals to moderately high burn-up levels in a fast neutron flux FUBR-1B in BEATRIX-I.** Hollenberg, G.; Alvani, C.; Rasneur, B.; Ebel, H.; Walker, D.E.; Takahashi, T.; Noda, K.; Akiyama, H. (Pacific Northwest Lab., Richland, WA (USA); ENEA, Casaccia (Italy). Centro Ricerche Energia; CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France); Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.); Japan Atomic Energy Research Inst., Tokai, Ibaraki; Mitsubishi Atomic Power Industries, Inc., Omiya, Saitama (Japan)). Aug 1987. Contract AC06-76RL01830. 11p. (CONF-871036—33). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005131/JAW.

From 3. international conference on fusion reactor materials; Karlsruhe, F.R. Germany (4 Oct 1987).

A solid tritium breeder irradiation experiment has been designed and fabricated. It began irradiation for 600 full power days in the fast neutron flux of the EBR-II reactor in order to obtain swelling, tritium retention, and stability data. Lithium ceramic pellets, spheres and single crystals from Europe, Japan and the USA are contained within 19 closed capsules. Burn-up levels from 10 to 35 x 10^{20} captures/cc will be obtained during this irradiation at "isothermal" temperatures on 1 cm diameter pellets from approximately 500 to 900°C. Larger diameter pellets (1.6 to 2.3 cm) will produce large temperature gradients and centerline temperatures of over 1200°C. Characterization of these materials provided an assessment of current fabrication capabilities which exist for these materials. 9 refs., 2 figs., 2 tabs.

23914 **(PNL-SA—15426) Dimensional change correlations for 20% cold-worked AISI 316 stainless steel for fusion applications.** Clark, R.W.; Kumar, A.S.; Garner, F.A. (Pacific Northwest Lab., Richland, WA (USA); Missouri Univ., Rolla (USA)). Nov 1987. Contract AC06-76RL01830. 8p. (CONF-8701110—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005681/JAW.

From International conference on fusion reactor materials-II; Karlsruhe, F.R. Germany (4 Jan 1987).

Correlations developed for void swelling and irradiation creep often arise from two separate data bases and sometimes are not well-matched, reflecting apparently minor but actually significant differences in environmental history. Previously published correlations are very empirical in nature and reflect prevailing misconceptions about the parametric sensitivity of swelling and irradiation creep. In this study a well-defined data base for swelling of 20% cold-worked AISI 316 is used in conjunction with the latest insights on swelling and creep to develop two matched dimensional change correlations for temperatures in the range of 300 to 650°C. The new creep model, in particular, is much simpler than the complicated empirical correlation published earlier for this steel. 18 refs., 6 figs.

23915 **(RAL—87-084) Local analytic approach for the fast solution of the Fokker-Planck equation.** Sajjadi, S.G.; Nicholas, D.J. (Rutherford Appleton Lab., Chilton (UK)). Nov 1987. 45p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752356/JAW.

In this report we describe a method of obtaining a closed form for the Focker-Planck equation rendering it amenable to solution in time-step with a complete hydrodynamic treatment of a plasma. We present a local expression for the heat flux, by solving the Focker-Planck equation for electrons in one space and two velocity dimensions in the presence of a self consistent electronic field.

23916 **(RISO-M—2649) Equipment for non-destructive diagnoses of pellets in flight.** Andersen, V.; Andersen, P. (Risoe National Lab., Roskilde (Denmark)). Jul 1987. 25p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88752049/JAW.

A non-destructive method to measure the mass and velocity of a pelle in flight has been demonstrated. Basically it has been developed for frozen deuterium pellets to be injected into a tokamak plasma, but i has general applications to measure the mass and velocity of pellets made of dielectric material.

23917 **(RISO-M—2663) Considerations of several real effects in pneumatic pellet injection processes.** Ming-Lun Xue. (Risoe National Lab., Roskilde (Denmark)). Oct 1987. 28p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752054/JAW.

Several real effects that take place in a pneumatic pellet injector are examined. These are the heat transfer between a high-temperature propellent gas and the metal wall of the injector, and the frictiona loss between the propellent and wall.

23918 **(UCID—21140) Preparing the Alcator C bolometer system for use on MTX [Microwave Tokamak Experiment].** Marinak, M. (Lawrence Livermore National Lab., CA (USA)). 9 Feb 1988. Contract W-7405-ENG-48. 19p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88006724/JAW.

The Alcator C bolometer array has been modified to be compatible with electron cyclotron heating on the Microwave Tokamak Experiment. Fine wire mesh screens are mounted on the front of the bolometer collimator tubes to attenuate microwave heating of the bolometers. Structural changes eliminate openings in the seams of the bolometer housing, which represent pathways for microwaves to enter the system. This paper outlines the operational principles of the bolometer system, discusses the measured and predicted performance characteristics of the bolometer array, and includes a concise guide to the operation of the bolometer controller. 5 refs., 5 figs., 1 tab.

23919 **(UCID—21150-Vol.1) TIBER II/ETR final design report: Volume 1, 1.0 Introduction; 2.0 plasma engineering.** Lee, J.D. (ed.). (Lawrence Livermore National Lab., CA (USA)). Sep 1987. Contract W-7405-ENG-48. 536p. NTIS, PC A23/MF A01; 1; GPO Dep. Order Number DE88006592/JAW.

This paper discusses the design of the TIBER II tokamak test reactor. Specific topics discussed are the physics objectives for Tiber, magnetics, baseline operating point, pulsed inductive operation, edge physics and impurity control, fueling, disruption control, vertical stability and impurity flow reversal. (LSP)

23920 **(UCID—21150-Vol.2) TIBER II/ETR final design report: Volume 2, 3.0 Engineering.** Lee, J.D. (ed.). (Lawrence Livermore National Lab., CA (USA)). Sep 1987. Contract W-7405-ENG-48. 699p. NTIS, PC A99/MF A01; 1; GPO Dep. Order Number DE88006608/JAW.

This paper discusses the design of the TIBER II Tokamak. This particular volume discusses: mechanical systems; electrical systems; shield nuclear analysis and tritium issues; reactor building facilities; and tritium systems. (LSP)

23921 **(UCID—21150-Vol.3) TIBER II/ETR final design report: Volume 3, 5.0 Radiation safety and environment; 6.0 Physics and technology R and D needs.** Lee, J.D. (ed.). (Lawrence Livermore National Lab., CA (USA)). Sep 1987. Contract W-7405-ENG-48. 160p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE88006609/JAW.

This paper discusses the design of the TIBER II Tokamak. This particular volume discusses: safety and environmental requirements and design targets; accident analyses; personnel safety and maintenance exposure; effluent control; waste management and decommissioning; safety considerations in building design; and safety and environmental conclusions and recommendations. (LSP)

23922 **(UCLA/PPG—1127) Particle collector scoops for improved exhaust in "axisymmetric" devices.** Conn, R.W.; Wolf, G.H. (California Univ., Los Angeles (USA). Plasma Physics Group). Nov 1987. Contract FG03-85ER51069. 17p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88006605/JAW.

Application of particle collector scoops in front of the pumping ducts of axisymmetric divertor/magnetic limiter configurations is proposed. These scoops should enclose a significant fraction of the recycling particles. The resulting increase in natural particle pressure in front of the pumping ducts leads to an improved exhaust efficiency. This can permit an extension of the operational

margin for density control. Alternatively, aiming at a prescribed exhaust flow in reactor-type devices such as INTOR, the pumping ducts could be reduced in aperture, leaving valuable space for other components. The lay-out of the proposed scheme depends on the heat load on the leading edge in front of the scoop and on the deflector in front of the pumping ducts. 14 refs., 5 figs.

23923 **Magnetic surface mapping with highly transparent screens on the Auburn torsatron.** Hartwell, G.J.; Gandy, R.F.; Henderson, M.A.; Hanson, J.D.; Swanson, D.G.; Bush, C.J.; Colchin, R.J.; England, A.C.; Lee, D.K. (Physics Department, Auburn University, Auburn, Alabama 36849). *Review of Scientific Instruments;* **59**: No. 3, 460-466(Mar 1988).

In stellarator-type magnetic confinement devices (of which the torsatron is one), the magnetic field is produced entirely by external, current-carrying coils. Two methods for mapping magnetic surfaces in the Auburn torsatron were tested and compared, both of which involve the use of highly transparent screens. The first method consists of coating the screen with a phosphor that emits light when struck by electrons emitted by an electron gun. A pattern representative of a magnetic surface is formed on the screen, and this pattern is recorded photographically. The second method uses an uncoated screen to collect electrons emitted from an emissive probe, which is scanned over a poloidal cross section of the torus. Under certain conditions, the collected current is a constant over a particular magnetic surface so that a contour plot of the current versus position is equivalent to a plot of the magnetic surfaces. Parametric studies of the two methods are presented, and the effectiveness of each technique is discussed.

23924 **Small multicusp H^- source.** Leung, K.N.; Ehlers, K.W.; Hauck, C.A.; Kunkel, W.B.; Lietzke, A.F. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Review of Scientific Instruments;* **59**: No. 3, 453-456(Mar 1988). Contract AC03-76SF00098.

High-quality H^- beams have been generated from a multicusp source equipped with a permanent magnet filter. It is shown that a large improvement in H^- yield can be achieved by employing a small multicusp source, fabricated with the proper wall material and extraction chamber length. From this small source, H^- current densities higher than 250 mA/cm^2 have been extracted from a 1-mm-diam aperture for a discharge voltage of 150 V and a discharge current of 450 A. When the source is operated with deuterium, the extractable negative ion current density is reduced by approximately 30%.

23925 **The data acquisition and control systems for ATF: An overview.** Stewart, K.A.; Baylor, L.R.; Greenwood, D.E.; Kannan, K.L.; Overbey, D.R.; Wing, W.R.; Summer, J.N.; De Van, W.R. (Oak Ridge National Lab., P.O. Box Y, Oak Ridge, TN 37831). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-34**: No. 4, 739-741(Aug 1987). (CONF-870552—). Contract AC05-84OR21400.

From 5. conference on real-time computer applications in nuclear, particle, and plasma physics; San Francisco, CA, USA (12 May 1987).

A data acquisition and control system is being developed to support the Advanced Toroidal Facility (ATF) at the Oak Ridge National Laboratory (ORNL). This system has two separate elements: a VAX-based data acquisition and management system and a status and control system that uses programmable logic controllers (PLCs). Although these systems can operate independently, they are intended to cooperate fully and complement one another. This paper presents an overview of the hardware components, software architecture, and operations of these systems.

23926 **SAMS - The synchronization and monitoring system for ATF data acquisition.** Greenwood, D.E. (Oak Ridge National Lab., P.O. Box Y, Oak Ridge, TN 37831). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-34**: No. 4, 912-913(Aug 1987). (CONF-870552—). Contract AC05-84OR21400.

From 5. conference on real-time computer applications in nuclear, particle, and plasma physics; San Francisco, CA, USA (12 May 1987).

SAMS performs much of the synchronization of the distributed data acquisition system for the Advanced Toroidal Facility (ATF). SAMS is responsible for propagating shot information and managing the data system directories and logical names. This paper describes how SAMS communicates with other processes, both within the VAX cluster that supports most of the ATF data acquisition and on VAXes that are connected to the cluster via DECnet.

23927 **The ATF data management system.** Kannan, K.L.; Baylor, L.R. (Oak Ridge National Lab., P.O. Box Y, Oak Ridge, TN 37831). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-34**: No. 4, 921-923(Aug 1987). (CONF-870552—). Contract AC05-84OR21400.

From 5. conference on real-time computer applications in nuclear, particle, and plasma physics; San Francisco, CA, USA (12 May 1987).

The Advanced Toroidal Facility (ATF) Data Management System (DMG) is a VAX-based software system that provides unified data access for ATF data acquisition and analysis. The system was designed with user accessibility, software maintainability, and extensibility as primary goals. This paper describes the layered architecture of the system design, the system implementation, use, and the data file structure.

23928 **The ATF status and control system.** Baylor, L.R.; Devan, W.R.; Summer, J.N.; Alban, A.M. (Oak Ridge National Lab., P.O. Box Y, Oak Ridge, TN 37831). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-34**: No. 4, 984-986(Aug 1987). (CONF-870552—). Contract AC05-84OR21400.

From 5. conference on real-time computer applications in nuclear, particle, and plasma physics; San Francisco, CA, USA (12 May 1987).

The Advanced Toroidal Facility (ATF) Status and Control System (SCS) is a programmable controller-based state monitoring and supervisory control system. This paper describes the SCS implementation and its use of a host computer to run a commercially available software package that provides color graphic interactive displays, alarm logging, and archiving of state data.

23929 **Overview of the compact ignition tokamak.** Flanagan, C.A. (CIT National Design Team, Oak Ridge National Lab., P.O. Box Y, FEDC Bldg., Oak Ridge, TN 37831). pp 375-380 of Fusion technology 1986. Elmsford, NY; Pergamon Books Inc. (1987). (CONF-860917—). Contract AC05-84OR21400.

From 14. SOFT - symposium on fusion technology; Avignon, France (8 Sep 1986).

A national team has developed a baseline concept for a Compact Ignition Tokamak (CIT). The CIT mission is to achieve ignition and provide experimental capability to study the behavior of burning plasmas. The design uses large magnetic fields on axis (about 10 T) and large plasma currents (about 9-10 MA). The magnet structure derives high strength from the use of a copper-Inconel composite plate design in the nose region of the toroidal field (TF) coil and in the ohmic heating solenoid. Inertial cooling is used; liquid nitrogen temperatures are established at the beginning of each pulse. Capability is provided to operate either with a divertor or limiter based plasma. The design is very compact (1.32-m major radius, 0.43-m plasma radius), has 16 TF coils, and has 16 major horizontal access ports, about 30 cm by 80 cm, located between TF coils. The schedule is for a construction project to be authorized for the period FY 1988-1993.

23930 **Pellet fueling development at ORNL.** Combs, S.K.; Milora, S.L.; Foster, C.A.; Schuresko, D.D.; Foust, C.R.; Simmons, D.W.; Beard, D.S. (Oak Ridge National Lab., P.O. Box Y, Oak Ridge, TN 37831). pp 355-360 of Fusion technology 1986. Elmsford, NY; Pergamon Books Inc. (1987). (CONF-860917—). Contract AC05-84OR21400.

From 14. SOFT - symposium on fusion technology; Avignon, France (8 Sep 1986).

Advanced plasma fueling systems for magnetic confinement devices are being developed at the Oak Ridge National Laboratory (ORNL). The general approach is that of producing and accelerat-

ing frozen hydrogenic pellets at speeds in the range of 1-2 km/s and higher. Two specific concepts are under development: (1) high-speed pneumatic acceleration and (2) mechanical (centrifugal) acceleration. Both approaches are being pursued to meet the projected pellet size and delivery rates for major near-term plasma confinement devices, such as the Tokamak Fusion Test Reactor (TFTR), Tora Supra, the Joint European Torus (JET), JT-60, and Doublet III-D (DIII-D), as well as future applications. In addition to these confinement physics related activities, ORNL is pursuing advanced technologies to achieve pellet velocities significantly in excess of the 2-km/s range already attained with pneumatic injectors and has embarked on a development program designed to explore the feasibility of fabricating and accelerating tritium pellets. This paper describes these ongoing activities.

23931 **Designs for a TFTR full-power pumped limiter.** Budny, R. (Plasma Physics Lab., Princeton Univ., Princeton, NJ 08544). pp 607-614 of Fusion technology 1986. Elmsford, NY; Pergamon Books Inc. (1987). (CONF-860917—).

From 14. SOFT - symposium on fusion technology; Avignon, France (8 Sep 1986).

A pumped-limiter system which would provide increases particle control and enhance the performance of full-power discharges is being considered for TFTR. The system consists of two toroidal belts located near the Zirconium-Aluminium (ZrAl) getter panels. The limiter blades would be made of carbon/carbon composite in order to have a very thin profile, allowing a large fraction of the scrape-off flux to be pumped. Simulations of the plasma scrape-off and neutral transport indicate that the limiter pumping should reduce the recycling coefficient by 10-25%. Simulations of central plasma processes indicate that the lowered recycling could increase Q/sub fusion/ by more than 100%. This paper discusses the designs and the performance predictions for the system.

23932 **Development of an EHD liquid lithium ion source for PBFA II.** Bieg, K.W.; Gerber, R.A.; Cap, J.S.; Rovang, D.C.; Pregenzer, A.L.; Woodworth, J.R.; Cianciabella, C.J.; Wiemann, D.K. (Sandia National Labs., Albuquerque, NM 87185). pp 5 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—). Contract AC04-76DP00789.

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

A liquid lithium anode is being developed as the primary lithium ion source for PBFA II. The operation of this source is based upon the electrohydrodynamic (EHD) distortion of the liquid surface to form cusps when subjected to high electric fields. These field-enhanced cusps emit ions by a field evaporation mechanism, similar to a conventional liquid metal ion source (LMIS). The fabrication of a vertical, liquid lithium-bearing anode compatible with the PBFA II ion diode has presented a rather formidable technological challenge. With molten lithium salts (e.g., LiNO/sub 3/), the authors constructed an anode which consists of a heated stainless steel porous panel, which wicks the molten salt from a bottom reservoir. With liquid lithium metal, they are currently favoring a technique whereby similar porous panels are preloaded with molten lithium by immersion in an inert atmosphere glove box. These preloaded panels are protected from corrosion during diode assembly with a thin coating of paraffin wax.

23933 **Thermal desorption of lithium from LIF flashover sources on Nereus.** Sweeney, M.A.; Burns, E.J.T.; Woodworth, J.R.; Bieg, K.W. (Sandia National Labs.). pp 5-6 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—). Contract AC04-76DP00789.

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

PBFA II requires a high-purity, large-area lithium ion source. A near-term lithium-fluoride flashover source for PBFA II has been studied with a magnetically insulated extraction diode on the 0.03-TW Nereus accelerator. Hydrocarbon adsorbates are removed from the anode surface by glow discharge cleaning, and XUV photons, created from surface discharges on a polyimide insulator with copper electrodes, dramatically lower the diode impedance. Such a flashover source is believed to require leakage electrons, in conjunction with the tangential component of the electric field at the conductor-dielectric-vacuum interface, in order to initiate the surface avalanche that forms the anode plasma. Thermal desorption estimates are important for LiF because measurements suggest the fluorine is expelled by stimulated desorption and ground-state lithium is then desorbed thermally from the remaining lithium-rich surface. However, since thermal desorption cannot occur until electrons trapped in the fluorine vacancies reach the surface layer and create neutral lithium, a thermal desorption time is a lower limit to the time for lithium desorption. Thermal desorption calculations for leakage electrons have been done, using voltage and current waveforms for a typical Nereus experiment.

23934 **The advanced toroidal facility.** Taylor, D.J. (Oak Ridge National Lab., Oak Ridge, TN 37831). pp 643-648 of Fusion technology 1986. Elmsford, NY; Pergamon Books Inc. (1987). (CONF-860917—). Contract AC05-84OR21400.

From 14. SOFT - symposium on fusion technology; Avignon, France (8 Sep 1986).

The Advanced Toroidal Facility (ATF) is a magnetic confinement device under construction at Oak Ridge National Laboratory (ORNL). The ATF is a type of stellarator known as a torsatron, which theoretically has the capability to operate at $\geq$ 8% beta in steady state. The ATF plasma has a major radius of 2.1 m, an average minor radius of 0.3 m, and a field of 2 T for 5-s pulses or 1 T steady state. The ATF device consists of a set of helical field (HT) coils, a set of poloidal field (PF) coils, an exterior shell structure to support the coils, and a thin helically contoured vacuum vessel inside the coils. The ATF replaces the Impurity Study Experiment (ISX-B) tokamak at ORNL and uses the ISX-B auxiliary systems, including power supplies, cooling, diagnostics, data acquisition, control, and 4 MW of neutral injection and 0.2 MW electron cyclotron heating. The ATF is scheduled to start commissioning in January 1987. An overview of the ATF device is presented, including details of the construction process employed and the present status of this work.

23935 **Physics of man-made extended magnetic structures in low earth orbit.** Sullivan, J.D.; Lane, B.G.; Irby, J.H.; Post, R.S. (Plasma Fusion Center, M.I.T., Cambridge, MA 02139). pp 71-72 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

Recently there have been proposals to place high field magnets aboard the Space Station. The introduction of such an extended magnetic field structure into low earth orbit raises a number of interesting plasma physics issues. For example, the ASTROMAG magnet would create an extended magnet field whose strength drops to the ambient level of .3 G over a scale length of approximately 10 m. The combined field from the cusp magnet and the earth produces a complex extended configuration with ring nulls which separate open from closed field lines. This configuration will move through the ambient 1 x 10/sup 5/ cm/sup -3/ plasma at a velocity of approximately 7 km/sec, a velocity slow compared to the Alfven speed, but fast compared to ion sound speed. The ambient plasma crosses the field structure in a time short compared to an ion Larmor period in the ambient field, but long compared to an electron Larmor period. Thus, electrons behave as a magnetized fluid while ions move ballistically until they approach and reflect from the higher fields near the cusp. Since the ambient plasma Debye length is short compared to the field scale length, an electrostatic shock structure forms to equilibrate the flows in order to achieve quasi-neutrality. The authors conjecture based on previous laboratory experiments that the ambient plasma will be excluded from a cavity surrounding the magnet.

23936 **Impact of some key plasma reactor performance parameters on the required price of single- and tandem-junction α-Si modules.** Wright, S.R.; Whisnant, R.A. (Research Triangle Institute, Research Triangle Park, NC 27709). pp 1261-1265 of Nineteenth IEEE photovoltaic specialists conference, 1987. (Conference Record). Piscataway, NJ; IEEE Service Center (1987). (CONF-870528—).

From 19. IEEE photovoltaic specialists conference; New Orleans, LA, USA (4 May 1987).

A previous analysis of PV module manufacturing cost showed that single- and tandem-junction α-Si modules may potentially be manufactured and sold in the $0.90/Wp to /1.60/Wp range if certain key processing parameters primarily associated with the plasma reactor are achieved. This paper compares in more detail tradeoffs in those parameters for both α-Si:H and α-Si:H/α-SiGe:H modules in the context of a 25 MW/yr manufacturing operation, as computed using a previously developed costing model called Interactive Manufacturing Cost Analysis Program (IMCAP). For these technology scenarios, achievement of sub-$1/Wp not only requires module efficiencies of at least 12-15%, but also plasma reactor yields >90%, i-layer depositions approaching 25A/s, and gas utilizations approaching 50%.

23937 **Analytical solution for a coaxial plasma gun: Weak coupling limit.** Dietz, D. (Air Force Weapons Lab., Plasma Physics Branch (AWPP), Kirtland AFB, NM 87117-6008). pp 52-53 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

The analytical solution of the system of coupled ODE's which describes the time evolution of an ideal (i.e., zero resistance) coaxial plasma gun operating in the snowplow mode is obtained in the weak coupling limit, i.e, when the gun is fully influenced by the driving (RLC) circuit in which it resides but the circuit is negligibly influenced by the gun. Criteria for the validity of this limit are derived and numerical examples are presented. Although others have obtained approximate, asymptotic and numerical solutions of the equations, the present analytical results seem not to have appeared previously in the literature.

23938 **Applications of MHD energy conversion to magnetic fusion reactors.** Logan, G. (Lawrence Livermore National Lab.). pp 53 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

Magnetic Fusion reactors have several characteristics which make them conducive to MHD energy conversion: (1) Large blanket volumes with high magnetic fields (100's of m/sup 3/ at B = 2 - 5 T). (2) Deeply penetrating neutrons and gammas which can heat high temperature pebble-beds behind tritium breeding zones, to produce high temperature heat suitable for MHD conversion (DT reactors) (3) No fission products which would tend to leak out of the high temperature pebbles above 1600°K. (4) Production of useful microwave synchrotron radiation from high temperature plasma electrons, which can be used to superheat gas or vapor in-situ, to temperatures much higher than ceramic wall temperatures. (Best for D-3He reactors) For DT reactors, use of an MHD Rankine cycle of Mercury seeded with Potassium yields a higher superheat temperature in a two-zone fusion blanket than possible with helium-cooled blanket in a Brayton cycle. Savings in piping and balance-of-plant is the goal, rather than high efficiency. D-3He can produce the largest ratio of P/sub microwave//P/sub fusion/ of all fusion fuel cycles, yielding highest MHD cycle efficiencies.

23939 **Numerical modeling of microwave superheaters for fusion.** Campbell, R.B.; Hoffman, M.A.; Barr, W.L.; Logan, B.G. (Univ. of California). pp 53 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

Microwave Superheating is a promising method of heating a flowing gas to temperatures greatly exceeding the temperatures of surrounding material walls. A potential application of this concept is the use of the synchrotron radiation emission from a hot, magnetically-confined thermonuclear plasma to superheat the working fluid in the inlet region of a magnetohydrodynamic (MHD) generator to temperatures above that practical from conventional thermal heat sources. The simplest embodiment of the idea would employ a gas seeded with a material low ionization potential (probably one of the alkali metals) flowing through a ceramic tube. The ceramic wall is resistant to high temperatures, and allows the penetration of the microwaves without attenuation and wall heating. The gas could be Mercury vapor in the full sized fusion-relevant superheater, and perhaps either Argon or Helium in a proof-of-principle experiment. There is currently interest in an experimental collaboration with the Japanese to demonstrate the feasibility of the concept. They have developed both one and two dimensional hydrodynamic codes to study microwave superheating.

23940 **The magnetic vapor shielding (MVS) mechanism for protection of components subjected to high heat flux.** Gilligan, J.G.; Hahn, D. (North Carolina State Univ., Raleigh, NC 27695). pp 86-87 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

Devices such as EM launchers have large naturally occurring magnetic fields (<10T) near the material surfaces exposed to very large heat fluxes. The fields may be sufficient to aid in the Magnetic Vapor Shielding (MVS) of materials undergoing surface melting and ablation due to the incident high heat flux. The MVS mechanism can reduce total melting and ablation erosion. The authors report on studies to model the edge plasma-material surface interface using a one-dimensional, time dependent, plasma code with local thermodynamic radiation transport. Special emphasis is given to the very low temperature (T/sub e/<10eV) and high plasma density (n/sub e/>10/sup 25/m/sup -3/) conditions that will exist in the plasma-surface boundary layer. Preliminary results indicate reductions in surface erosion approaching 40% compared to cases where no magnetic field is present. This is significant for the design of devices where surface erosion is a major concern.

23941 **Computational modeling of the reconnection gun.** Freeman, J.R. (Sandia National Labs., Albuquerque, NM). pp 87 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

A 2-D finite-difference code named REGGIE has been written to model the combined diffusion and convection of flux in the projectile of inductively coupled electromagnetic launchers. The model is based on the usual single-component cartesian vector potential equation describing flux diffusion and convection. The code integrates the J x B forces spatially and temporally to provide the net accelerating force. Variable spatial zoning is used to resolve the small skin depths. A variable time step is used to reduce the computational time required after crowbar. Implicit second-order differencing is used for stability and accuracy. The finite-difference equations are solved by a simple successive-order-relaxation technique. Although this is an unsophisticated method, it allows the arbitrary zoning in both directions and the implicit time differencing. The good initial guesses available from the previous time-step aid convergence of the solution. Additional details of the code are described and experimental comparisons presented.

23942 **CIT vacuum chamber conceptual design and analysis'.** Gallix, R.; Listvinsky, G. (GA Technologies Inc., P.O. Box 85608, San Diego, CA 92138). pp 553-560 of Fusion technology 1986. Elmsford, NY; Pergamon Books Inc. (1987). (CONF-860917—).

From 14. SOFT - symposium on fusion technology; Avignon, France (8 Sep 1986).

This paper describes the conceptual design and analysis of the vacuum chamber for the Compact Ignition Tokamak (CIT). The chamber consists of the first wall (FW), divertor, and vacuum vessel (VV) assemblies. The FW and divertor are constructed of inertially cooled graphite tiles which entirely cover the VV. The latter is a continuous, resistive shell of Inconel 625 cooled with gaseous nitrogen. Thermal and stress analysis of FW and divertor have established a nominal tile thickness of 1.0 cm and a maximum allowable FW surface heat flux of 11.0 MW/m/sup 2/. Calculations have shown that for a cooldown time of one hour, the required tile-to-VV thermal conductance is >0.1 W/K. Estimates of worst-

case electromagnetic loads and resulting stresses on the VV during plasma disruptions have shown the maximum stress levels to be below the allowable limits for the VV material.

23943 **Bistability, hysteresis and transitions to chaos in a model of coherent, unimolecular excitation.** Englund, J.C.; Bowden, C.M.; Hopf, F.A. pp 101 of Optical chaos. Chrostowski, J.; Abraham, N.B. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1986). (CONF-860620—).

From Society of Photo-Optical Instrumentation Engineers international symposium: topics in optical and optoelectronic applied sciences and engineering; Quebec City, Canada (2 Jun 1986).

A model describing the dynamics of an irradiated SF/sub 6/ molecule was previously shown to yield chaotic trajectories. The authors found that neutrally stable oscillatory states are also possible within windows of the parameter space. When dissipation is added to the model, they found bistability, both between fixed points and limit cycles, and between limit cycles and other limit cycles. By dynamically varying the laser detuning, the authors prove that hysteresis cycles result.

99 GENERAL AND MISCELLANEOUS

23944 **(DOE/MA—0318) Department of Energy annual procurement and financial assistance report, FY 1987.** (USDOE Assistant Secretary for Management and Administration, Washington, DC. Directorate of Procurement and Assistance Management). Feb 1988. 37p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006726/JAW.

DOE is involved in basic and applied research in a wide range of technology areas including the following: nuclear energy, nuclear waste management, fossil energy, conservation, renewable energy, and nuclear weapons development. The DOE procurement activities also support national security in the production and testing of nuclear weapons and the management of the Strategic Petroleum Reserve and the Naval Petroleum and Oil Shale Reserves. With the exception of the national security activities and departmental administration, DOE spends its procurement dollars more as a catalyst for technology development than for acquiring goods and services for federal use. DOE enters into contractual arrangements with large and small firms involved in the technology areas for which it is responsible. In addition, DOE is involved in contractual and financial assistance activities with educational institutions, nonprofit organizations, and state and local governments. A significant portion of DOE's mission is carried out by contractors operating DOE-owned plants and laboratories. DOE offers substantial opportunities for small and small disadvantaged business enterprises, both as DOE prime contractors and as subcontractors to the management and operating contractors.

23945 **(DOE/MA/00356—H1) 1987 national compensation survey of research and development scientists and engineers: Final report, data effective date: January 15, 1987.** (Hay Group, Washington, DC (USA)). Feb 1988. Contract AC01-86MA00356. 389p. NTIS, PC A17/MF A01; 1; GPO Dep. Order Number DE88006835/JAW.

This report presents the results of the first in a series of new surveys of compensation and benefits for research and development (R and D) scientists and engineers (S and Es). The 1987 Survey represents the largest nationwide database of its kind, covering 104 establishments which provided data on over 40,000 degreed researchers in the "hard" sciences. The new survey incorporates a number of major enhancements designed to improve the quality and utility of the results.

23946 **(DOE/MI—0009) Proceedings of the program review on alliances with minority colleges and universities.** (USDOE Office of Minority Economic Impact, Washington, DC; USDOE San Francisco Operations Office, Oakland, CA; Lawrence Berkeley Lab., CA (USA); Lawrence Livermore National Lab., CA (USA)). 1987. 198p. (CONF-8706273—). NTIS, PC A09. Order Number DE88006604/JAW.

From Program review on alliances with minority colleges and universities; Oakland, CA, USA (28 Jun 1987).

Eight speeches are included, together with workshop notes, materials, and appendices. Some of the pertinent papers are processed separately for the data base. (DLC)

9901 Management

REFER ALSO TO CITATION(S) 23964

23947 **(DOE/MA—0329) Productivity Management Program: Manual.** (USDOE Assistant Secretary for Management and Administration, Washington, DC. Office of Organization and Management Systems). Jan 1988. 87p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88006559/JAW.

The Department of Energy (DOE) has an ongoing effort to maximize productivity, including its Productivity Management Program (PMP), Manpower Management Survey Program (MMSP) and the Manpower utilization Reporting System (MURS). The productivity effort has three major goals: to develop quantitative and qualitative measures against which the productivity of individual organizations and functions can be measured; to provide a systematic process by which managers can measure their productivity and incorporate the results in formal reporting systems to Departmental management, the Office of Management and Budget, Congress and other appropriate bodies; and to promote productivity improvement.

23948 **(DOE/MA—0330) Annual report to Congress on competition in contracting, FY 1987.** (USDOE Assistant Secretary for Management and Administration, Washington, DC. Agency Competition Advocate). 1987. 25p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006251/JAW.

This report provides an overview of DOE's organizational structure and contracting activities that support the Department's various technological and production missions. DOE's mission includes basic and applied research in such areas as nuclear, solar, geothermal, and fossil energy; civilian and defense radioactive waste management; and conservation programs. The Department also supports national defense/national security efforts through the development and production of nuclear weapons and naval reactors, and through the management of petroleum and oil shale reserves. Additionally, the Department manages and operates five power administrations that sell and distribute electric power in various regions of the United States. This report also includes a description of the contracting arrangement used when contracting for the management and operation of the DOE's national laboratories, defense related, and other facilities.

23949 **(EGG-NTA—7723) Syllabus Information Depiction System (SIDS) user's guide.** Waterman, D.K.; Skinner, N.L. (EG and G Idaho, Inc., Idaho Falls (USA)). Oct 1987. Contract AC07-76ID01570. 85p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88005527/JAW.

The Syllabus Information Depiction System (SIDS) is an automated tool designed to track the aircrew training syllabi of the Marine Corps. This report is the User's Manual for this data base system, providing users with instructions to help them use the system more efficiently. This document contains printed screen layouts that will guide the user step-by-step through the written instructions.

23950 **(INIS-BR—941) Scientific and technical production from IPEN - 1986.** (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo (Brazil)). 1987. 18p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701596/JAW.

This bulletin contains scientific and technical papers published by the researches from Instituto de Pesquisas Energeticas e Nucleares (IPEN), related to nuclear energy. 185 refs. (E.G.).

23951 **(INIS-XN—115) NEA activities in 1986. 15. Activity report of the OECD Nuclear Energy Agency.** (Nuclear Energy Agency, 75 - Paris (France)). 1987. 46p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701098/JAW.

Also published in French.

This report presents the main features of the Agency work during 1986. It deals with the response of NEA to the Chernobyl Accident; trends in Nuclear Power; Nuclear development and the fuel cycle; Nuclear safety research and licensing; radiation protection and waste management; legal affairs, nuclear science; joint undertakings and other NEA joint projects; information programmes; organization and administration.

23952 **(PAEC(A)IV-C—86014) 1986 PAEC Technical progress report.** (Philippine Atomic Energy Commission, Diliman, Quezon City). 1987. 138p. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701212/JAW.

Presented are on-going research and development projects of the Philippine Atomic Energy Commission in the fields of agriculture and natural resources, health and nutrition, supportive research, nuclear applications services, industry and energy, and other scientific and technological services and information system. (ELC).

9902 Mathematics And Computers

REFER ALSO TO CITATION(S) 20784, 21559, 21647, 21648, 22239

23953 **(AD-A—186896/7/XAB) Communications patterns in a symbolic multiprocessor. Technical report.** Nuth, P.R. (Massachusetts Inst. of Tech., Cambridge (USA). Lab. for Computer Science). Jun 1987. 194p. (MIT/LCS/TR—395). NTIS, PC A09/MF A01.

An important design decision for large-scale multiprocessors is the balance of processor power to communication-network bandwidth. In order to evaluate different design alternatives, it is necessary to be able to predict the load imposed on the network by a programming model. This thesis quantifies that communication load for a model of parallel symbolic computing using the Multilisp language. An organization of a shared-memory multiprocessor for Multilisp is proposed. The Nusim architectural simulator is built to model that organization. Several Multilisp application programs are run under Nusim, and the communication requirements of each program is measured. The locality of reference of memory accesses for the benchmarks is determined for three proposed multiprocessor topologies. The effect of scheduling decisions in increasing locality of access and in reducing global communication is studied. The thesis concludes with implications of scheduling policies on the design of parallel-computer systems.

23954 **(AD-A—187031/0/XAB) FX-87 reference manual. Edition 1.0. Technical report.** Gifford, D.K.; Jouvelot, P.; Lucassen, J.M.; Sheldon, M.A. (Massachusetts Inst. of Tech., Cambridge (USA). Lab. for Computer Science). Sep 1987. 165p. (MIT/LCS/TR—407). NTIS, PC A08/MF A01.

The FX programming language is designed to support the parallel implementation of applications that perform both symbolic and scientific computations. Unlike previous languages, FX uses an effect system is part of a kinded type system with three basic kinds: types, which describe the value of an expression; effects, which describe the side-effects that an expression may have; and regions, which describe the areas of the store in which side-effects may occur. Types, effects, and regions are collectively called descriptions. FX expressions can be abstracted over any kind of description. This permits type, effect, and region polymorphism. Unobservable side-effects are masked by the effect system are a conservative approximation of the actual side-effect masking make the FX effect system substantially more powerful than previous approaches to side-effect analysis.

23955 **(AD-A—187034/4/XAB) Multithreaded processor architecture for parallel symbolic computation. Technical report.** Fujita, T. (Massachusetts Inst. of Tech., Cambridge (USA). Lab. for Computer Science). Sep 1987. 74p. (MIT/LCS/TM—338). NTIS, PC A04/MF A01.

This paper describes the Multilisp Architecture for Symbolic Applications (MASA), which is a multithreaded processor architecture for parallel symbolic computation with various features intended for effective Multilisp program execution. The principal mechanisms exploited for this processor are multiple contexts, interleaved pipeline execution from separate instruction streams, and synchronization based on a bit in each memory cell. The tagged architecture approach is taken for Lisp program execution, and trap conditions are provided for future object manipulation and garbage collection.

23956 **(AD-A—187038/5/XAB) Computational models and task scheduling for parallel sparse Cholesky factorization. Final report, 1 October 1986-30 September 1987.** Liu, J.W. (Oak Ridge National Lab., TN (USA)). Oct 1986. 18p. NTIS, PC A03/MF A01.

Pub. in Parallel Computing, Vol. 3, No. 4, 327-342(Oct 1986).

In this paper, a systematic and unified treatment of computational task models for parallel sparse Cholesky factorization is presented. They are classified as fine-, medium-, and large-gained graph models. In particular, a new medium-grained model based on column-oriented tasks is introduced, and it is shown to correspond structurally to the filled graph of the given sparse matrix. The task-scheduling problem for the various task graphs is also discussed. A practical algorithm to schedule the column tasks of the medium-grained model for multiple processors is described. It is based on a heuristic critical path scheduling method. This will give an overall scheme for parallel sparse Cholesky factorization, appropriate for parallel machines with shared-memory architecture like the Denelcor HEP.

23957 **(AD-A—187072/4/XAB) Image chunking: defining spatial building blocks for scene analysis. Technical report.** Mahoney, J.V. (Massachusetts Inst. of Tech., Cambridge (USA). Artificial Intelligence Lab.). Apr 1987. 186p. (AI-TR—980). NTIS, PC A09/MF A01.

Rapid judgments about the properties and spatial relations of objects are the crux of visually guided interaction with the world. Vision begins, however, with essentially pointwise representations of the scene, such as arrays of pixels or small edge fragments. For adequate time performance in recognition, manipulation, navigation, and reasoning, the processes that extract meaningful entities from the pointwise representations must exploit parallelism. This report develops a framework for the fast extraction of scene entities, based on a simple, local model of parallel computation. An image chunk is a subset of an image that can act as a unit in the course of spatial analysis. A parallel preprocessing stage constructs a variety of simple chunks uniformly over the visual array. On the basis of these chunks, subsequent serial processes locate relevant scene components and assemble detailed descriptions of them rapidly. This thesis defines image chunks that facilitate the most potentially time-consuming operations of spatial analysis - boundary tracing, area coloring, and the selection of locations at which to apply detailed analysis. Fast parallel processes for computing these chunks from images, and chunk-based formulations of indexing, tracing, and coloring are presented. These processes were simulated and evaluated on the LISP machine and the connection machine.

23958 **(AD-A—187559/0/XAB) Theory and practice of fault tolerance in distributed systems. Final report, 15 June 1985-14 October 1986.** Chandy, K.M.; Misra, J. (Texas Univ., Austin (USA). Dept. of Computer Sciences). 30 Mar 1987. 12p. NTIS, PC A03/MF A01.

This work has concentrated on developing a unifying framework, under the name UNITY, for studying problem solving in parallel programming independent of specific architectural considerations. A simple model of computation and a logic were proposed to reason about properties of such programs, and problems from a variety of problem areas were studied. A number of transformations were developed that are appropriate for implementations on a

variety of architectures: sequential, asynchronous shared-memory, distributed message passing, synchronous parallel with shared memory, systolic arrays, and VLSI chips. The diversity of the application areas and the architectures studied lends credence to the hypothesis that there is a UNITY to computer programming.

23959 (ANL—87-50) Activities and operations of the Advanced Computing Research Facility, October 1986-October 1987. Pieper, G.W. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 32p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88006223/JAW.

This paper contains a description of the work being carried out at the advanced computing research facility at Argonne National Laboratory. Topics covered are upgrading of computers, networking changes, algorithms, parallel programming, programming languages, and user training. (LSP)

23960 (ANL/MCS-TM—105) The global convergence of partitioned BFGS on problems with convex decompositions and Lipschitzian gradients. Griewank, A. (Argonne National Lab., IL (USA)). Dec 1987. Contract W-31109-ENG-38. 30p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88006249/JAW.

The main pupose of this paper is the extension of Powell's global convergence result to the partitioned BFGS method introduced by Griewank and Toint. Even in the unpartitioned case the original result is strengthened because the search directions need not be computed exactly and the gradient is only required to be Lipschitzian rather than differentiable. Using the PSI - functional of Byrd an Nocedal a strong form of R-superlinear convergence is obtained if the gradients are uniformly convex and strictly differentiable at the minimizer /sub *x/. In order to deal with the possibility of singular functions we utilize a damping of the BFGS update that becomes inactive if the problem turns out to be regular near x/sub *x/. 30 refs.

23961 (ANL/MCS-TM—107) Trust regions and projected gradients. More, J.J. (Argonne National Lab., IL (USA)). Jan 1988. Contract W-31109-ENG-38. 16p. (CONF-8708220—1). NTIS, PC A03/MF A01; GPO Dep. Order Number DE88005829/JAW.

From 13. IFIP conference on system modelling and optimization; Tokyo, Japan (31 Aug 1987).

The numerical solution of large scale linearly constrained problems by algorithms which use the gradient projection method is a promising research area. Algorithms based on the gradient projection method are able to drop and add many constraints at each iteration, and this ability gives them an important advantage in large scale problems. In this paper we show how the ideas from the gradient projection method combine with trust region methods, and we give an indication of the powerful convergence results that are available for algorithms of this type. 14 refs.

23962 (BNL—40740) On the norm equivalence of singularly perturbed elliptic difference operators. Goldstein, C.I.; Parter, S.V. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 25p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006353/JAW.

Consider the system of linear algebraic equations L/sub h,k/ U = f which arises from the finite-difference discretization of the singularly perturbed elliptic operator where $1 << K < \infty$, $0 \leqq \sigma \leqq 1$. In this work we are concerned with preconditioning operators L/sub K,h/ so that: the condition number [(L/sub K,h/)$^{-1}$L/sub K,h/] and the condition number [L/sub K,h/(L/sub K,h/)$^{-1}$] is bounded independently of h and there are bounds on the growth of these condition numbers as a function of K. 10 refs.

23963 (CEA-CONF—9069) Improvement of the efficiency of two-dimensional multigroup transport calculations assuming isotropic reflection with multilevel spatial discretisation. Stankovski, Z.; Zmijarevic, I. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. d'Etudes Mecaniques et Thermiques). Jun 1987. 14p. (CONF-8706269—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88752136/JAW.

From 31. Yugoslav conference (ETAN '87); Bled, Yugoslavia (1 Jun 1987).

This paper presents two approximations used in multigroup two-dimensional transport calculations in large, very homogeneous media: isotropic reflection together with recently proposed group-dependent spatial representations. These approximations are implemented as standard options in APOLLO 2 assembly transport code. Presented example calculations show that significant savings in computational costs are obtained while preserving the overall accuracy.

23964 (CONF-871248—2) Modifying FMS-11 to provide read-with-timeout and video attribute control. Kulaga, J.E. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005986/JAW.

From Digital Equipment Computer Users Society fall symposium; Anaheim, CA, USA (7 Dec 1987).

FMS-11/RSX V2.0 is a forms-oriented video I/O management system that is well suited for use in traditional data entry applications. A recent attempt to use FMS-11 in a real-time process control application exposed several deficiencies. This paper describes modifications and additions to FMS-11 required by the application, such as video attribute control, "read-with-timeout," and programmable default menu responses. Some discussion is presented on the techniques used to approach this type of problem.

23965 (CONF-880433—1) A mixed-modem approach to data isolation on a broadband local area network. Crutcher, R.I.; Ewing, P.D. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004734/JAW.

From Southeastcon '88 conference and exhibit; Knoxville, TN, USA (10 Apr 1988).

Data isolation is required to broadband networks to prevent unauthorized access to the sensitive data of other users. Isolation can be obtained by using equipment from more than one manufacturer to introduce incompatibility between nonassociated users. This paper develops the basis for isolation and postulates that four layers of isolation will exist when the proper equipment is chosen. An experimental broadband local area network (LAN) was constructed to verify isolation. This independent network allowed variations in operating conditions without causing interference in normal broadband operations. The measured results indicate that a broadband LAN can transmit data of varying sensitivity levels without compromising data security. When combined with certain administrative restrictions, the mixed-modem technique provides a cost-effective method of sharing a broadband network while maintaining isolation of data having different sensitivities. 5 refs., 2 figs.

23966 (CONF-880462—1) Design and implementation of a parallel computer for expert system applications. Butler, P.L.; Allen, J.D. Jr.; Bouldin, D.W. (Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville (USA)). 1988. Contract AC05-84OR21400. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005288/JAW.

From SPIE's technical symposium on optics, electro-optic and sensors; Orlando, FL, USA (4 Apr 1988).

A parallel computer for high-speed execution of expert system programs has been designed and implemented at the Oak Ridge National Laboratory. Programs written in the popular OPS5 language for serial machines need not be modified by the programmer, since the compiler on this special-purpose machine automatically employs the parallelism inherent in the language. Performance improvements of a factor of 10 over serial machines have already been demonstrated. The initial hardware implementation of the parallel architecture consists of a host computer that broadcasts to 64 parallel rule processors over a transmit-only bus. The communication time is kept to a minimum by using direct-memory access and a memory-mapped addressing scheme that permit each of the parallel rule processors to receive the appropriate information simultaneously. A wired-OR completion flag signals the host whenever all of the parallel rule processors have finished their recognition tasks. The host then extracts information from those rule processors whose rules have been satisfied and, based on a global criterion, selects one of these rules. The host then carried out the actions dic-

tated by this rule and broadcasts new information to the rule processors to begin another recognize-act cycle. Statistics detailing the activities of the host and all of the rule processors are collected and displayed in real time. Thus, the performance of the various aspects of the architecture can be readily analyzed. Also, the execution of the expert system program itself can be studied to detect situations that may be altered to permit additional speedup.

23967 **(CONF-8608206—1-Draft) Preconditioned conjugate gradient algorithms and software for solving large sparse linear systems.** Young, D.M.; Jea, K.C.; Mai, Tsun-Zee. (Texas Univ., Austin (USA). Center for Numerical Analysis). Mar 1987. Contract AS05-81ER10954. 31p. (CNA—207). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002180/JAW.

From SIAM meeting on linear algebra in signals and control; Boston, MA, USA (1 Aug 1986).

The classical form of the conjugate gradient method (CG method), developed by Hestenes and Stiefel, for solving the linear system $Au = b$ is applicable when the coefficient matrix A is symmetric and positive definite (SPD). In this paper we consider various alternative forms of the CG method as well as generalizations to cases where A is not necessarily SPD. This analysis includes the "preconditioned conjugate gradient method" which is equivalent to conjugate gradient acceleration of a basic iterative method corresponding to a preconditioned system. Both the symmetrizable case and the nonsymmetrizable case are considered. For the nonsymmetrizable case there are very few useful theoretical results available. A package of programs, known as ITPACK, has been developed as a tool for carrying out experimental studies on various algorithms. Preliminary conclusions based on experimental results are given. 42 refs.

23968 **(DOE/ER/13378—T1) [Support of the Numerical Data Advisory Board]: Report of activities performed for the period July 1, 1985-June 30, 1986.** (National Research Council, Washington, DC (USA). Numerical Data Advisory Board). 1986. Contract FG05-85ER13378;FG05-82TC11278;FG05-82TC11276. 28p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005357/JAW.

This paper discusses the accomplishments of the Numerical Data Advisory Board, the US National Committee for Codata and Committee on Fundamental Constants. (LSP)

23969 **(DOE/ER/25009—487) The Caltech Concurrent Computation Program: Annual report, 1986-1987: Draft.** Fox, G.C.; Messina, P. (California Inst. of Tech., Pasadena (USA)). 24 Nov 1987. Contract FG03-85ER25009. 97p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88005813/JAW.

We survey the research of the Caltech Concurrent Computation Program (C^3P) in the period covering approximately September 1, 1986 to October 30, 1987. C^3P is an integrated multi-disciplinary research effort centered on the study of parallel systems and the hypercube, in particular. The research covers areas of computer systems, hardware, software, and algorithms but we emphasize an application based point of view. In the future, we see a growing importance in the areas of software tools, supercomputing for a broad range of architectures, and neural networks.

23970 **(DOE/ER/25015—6) The elliptic sinh-Gordon equation and the construction of toroidal soap bubbles.** Spruck, J. (Massachusetts Univ., Amherst (USA)). Oct 1987. Contract FG02-86ER25015. 37p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006426/JAW.

In this paper we study all positive solutions to the nonlinear eigenvalue problem $\Delta u + \lambda \sinh u = 0$ on a symmetric domain D. We characterize the limit solution as λ tends to zero. For a rectangle we prove that the solutions are unique and have a hidden additional symmetry property. This equation figures prominently in recent work on the construction of compact soap bubbles of genus 1. 11 refs.

23971 **(FEI—1773) Method for accounting under-estimated functionals when Monte Carlo method solution of the problems of radiation deep inelastic transmission.** Kagalenko, I.Eh.; Androsenko, P.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1986. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701008/JAW.

A problem of radiation field characteristics estimations by the Monte-Carlo method at large distances from a source and a problem of underestimation of mathematical expectation by average sampling occuring at a finite number of method realization are considered. Using asymptotic decomposition of a distribution function of mathematical expectation, a mechanism of underestimation of the latter is shown, a correction allowing to compensate underestimation is calculated. A confidence interval asymmetric relatively to mathematical expectation is built. The results of test calculations are given. 2 refs.; 2 figs.; 1 tab.

23972 **(FRNC-TH—3158) Contribution to a decision making model for analogical measurement validation.** Kaisergruber, I. (Paris-11 Univ., 91 - Orsay (France)). Mar 1985. 168p. (In French). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88752104/JAW.

In limits of studies taken on validity of analogic measures in nuclear power plant's operation, the present thesis takes aim at establishment of a model to reaching a decision on the indice of probability on measures obtained by preliminary validation system. In a first step, it is proposed to retain a system made by redundant measures in which the calcul of measures is based on the coherence between measures themselves and logic vote. In the second step, one equation is proposed to compute the index of probability of measures taken in account, the characteristics of the system.

23973 **(FRNC-TH—3166) Commutative convergence of a knowledge structures system: L.R.C. software applied to a project of computer assisted control of a nuclear power plant.** Hery, J.F. (Ecole Centrale des Arts et Manufactures, 92 - Chatenay-Malabry (France)). Jun 1985. 481p. (In French). NTIS (US Sales Only), PC A21/MF A01. Order Number DE88752105/JAW.

For operating continuous process, the conceptors of control room are confronted with two major problems: what is the optimal distribution of works between operators and machinery and what interface between them. The development of expert systems can made easier the solutions of these problems. In this work, we proposed to present the walk to make a model of expert system based on control of nuclear reactor. The major problems described here, are those of convergence and commutativity of knowledge's bases. We have formulated some necessary conditions to assure these two major properties for the bases.

23974 **(IAE—4358/15) Software for the KONUS-M online measurement system. Mass memory data base for operation with CAMAC equipment.** Solov'ev, V.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1986. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701032/JAW.

Mass memory data base (DB), having parameters of CAMAC units which are equipment part of the "KONUS-M" online measurement system, used in nuclear-physical experiments, is described. Separation of parameters of access to units from the body of programs permitted to avoid changes in software, caused by changes in the "KONUS-M" equipment. Technique of DB development is presened. A list of software means, permitting to formalize operation with tables and to make it "transparent" for a user, is given. 5 tabs.

23975 **(IAEA-R—4096-F) Development of neutron activation analysis software. Final report for the period June 1985-May 1987.** Wang Liyu. (International Atomic Energy Agency, Vienna (Austria)). Oct 1987. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701044/JAW.

The software for quantitative neutron activation analysis was developed to run under the MS/DOS operating system. The programmes of the IBM/SPAN include: spectra file transfer from and to a Canberra Series 35 multichannel analyzer, spectrum evaluation routines, calibration subprogrammes, and quantitative analysis. The programmes for spectrum analysis include fitting routine for separation of multiple lines by reproducing the peak shape with a combination of Gaussian and exponential terms. The programmes were tested on an IBM/AT-compatible computer. The programmes and the sources are available costfree for the IAEA projects of Technical Cooperation. 7 refs, 3 figs.

23976 (INIS-SU—433, pp 55-56) **Simulation program for orientational effects in radiative damage of crystals by charged particles.** Gann, V.V.; Dyul'dya, S.V.; Rozhkov, V.V. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1987. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780050/JAW.

Voprosy Atomnoj Nauki i Tekhniki.; no. 1(39).

In Radiation damage physics and science of materials.

For interpretation of experimental results obtained by means of a channeling technique of fast charged particles in crystals the usage of mathematical simulation methods is appeared to be perspective. CHADYN/2 program developed in KhPTI and designed for simulation of primary processes of oriented interaction of charged particles with crystals under axial channeling conditions as well as a wide circle of secondary effects, predominantly related to radiation damage and excitaton of a crystal electron subsystem, is described. Algorithm realized in the program is based on a numerical calculation of classic trajectories of channeled particles with provision for multiple scattering with thermal oscillations and crystal electrons according to the Monte Carlo method. The program permits to investigate kinetics of channeled particle flux evolution in a channel, orientation dependences of efficiency of crystal radiation damage and damage profils. There is a possibility for simulation of charged particle surface channeling effect. 2 refs.

23977 (ITEF—143(1986)) **Operation with physical experiment data on ES magnetic tapes using the BESM-6 computer.** Matsyuk, M.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1986. 24p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701117/JAW.

An applied program package to process physical information recorded in magnetic tapes with ES BESM-6 computer is developed. A recording form and software to read, records and data processing are described. Typical errors of computers when tape recording and ways of their correction in the framework of the subprograms developed are analysed. 7 refs.

23978 (JAERI-M—87-010) **Accuracy estimation for intermediate and low energy neutron transport calculation with Monte Carlo code MCNP.** Kotegawa, H.; Sasamoto, N.; Tanaka, S. (Japan Atomic Energy Research Inst., Tokyo). Feb 1987. 32p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE87702963/JAW.

Both measured radioactive inventory due to neutron activation in the shield concrete of JPDR and measured intermediate and low energy neutron spectra penetrating through a graphite sphere are analyzed using a continuous energy model Monte Carlo code MCNP so as to estimate calculational accuracy of the code for neutron transport in thermal and epithermal energy regions. Analyses reveal that MCNP calculates thermal neutron spectra fairly accurately, while it apparently over-estimates epithermal neutron spectra (of approximate 1/E distribution) as compared with the measurements.

23979 (JINR—R-10-86-844) **Organization of the problem-oriented graphical subroutine package for spectrometrical experiment automation systems.** Ostrovnoj, A.I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1986. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701180/JAW.

Subroutine package in Pascal developed for realization of functions of operative analysis and visualization on colour raster display of multidimensional spectrometrical information is described. The package is intended for using in software of the systems based on mini- or microcomputers in order to automate spectrometrical experiments. The peculiarity of realization of this package is using of a parameter file describing the generated picture and problem-oriented algorithms of picture generation. The parameter files with the basic spectrometrical information could be used for repetitive graphical output (possibly to plotter), its transportation or creating the graphical database. The package was used for designing interactive program for operative analysis and preliminary processing of multidimensional spectra on the PDP-11 type computer with RSX-11M operating system. 9 refs.; 2 figs.; 1 tab.

23980 (JINR—R-10-87-207) **Program for registration, acquisition and preliminary analysis of spectrometric information obtained with the aid of the KRION-2 setup.** Kartashov, S.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1987. 9p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701182/JAW.

A program for microcomputers based on INTEL-8085 microprocessors intended for registration and preliminary analysis of spectrometric information obtained with the aid of physical setups of the KRION ion source type is described. The program provides pulse analyzer functions and makes it possible to realize the spectrum collection into one or two data arrays simultaneously (from two ADCs) and to display the accumulated spectra on a colour TV-monitor as a histogram, on a terminal screen or a printer as a table. It also allows to write the dataonto a magnetic tape (MT), to perform arithmetic operations on different data arrays, to load the data from MT into the computer memory for subsequent display on the screen of TV-monitor and to calculate minimum statistical information for a separated spectrum part. 4 refs.; 2 figs.

23981 (JINR—R-10-87-249) **Program for modelling of the spectra of elastically ions.** Il'khamov, R.A.; Makhajdik, D. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1987. 4p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701184/JAW.

The interactive computer program for the analysis of complex multilayer samples is described. The method is based on the modelling of the energy spectra of backscattered ions and their subsequent comparison with experimental ones measured with proton or helium-4 ion beams. The energy straggling of ions and energy resolution were taken into account. The developed program has been written in FORTRAN-77 for PDP-11/70 computer operated under RSX-11M-PLUS system. 3 refs.; 2 figs.

23982 (KFTI—87-15) **Measuring multicomputer complex for track information processing.** Bratashevskij, A.S.; Voloshchuk, V.I.; Demidenko, I.A.; Eran, L.V.; Zolenko, V.A.; Karasev, S.P.; Fedorova, V.V. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1987. 5p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701194/JAW.

Soft- and hardware components of measuring multicomputer complex (MMCC) for stereotracks processing designed at Kharkov Physico-Technical Institute on the basis of uniform microcomputers "Ehlektronika-60" are described. MMCC has a star-shaped structure, intercomputer communication is carried out by standard blocks (500A, UPO). Software of central microcomputer "Ehlektronika-60" controlling the operation of peripheral computers is described. The system includes up to 22 peripheral computers "Ehlektronika-60". 3 figs.

23983 (KFTI—87-16) **Software and hardware for automated measure of stereophotography on semiautomatic event measure device and semiautomatic decoder.** Bratashevskij, A.S.; Voloshchuk, V.I.; Demidenko, I.A.; Eran, L.V.; Zolenko, V.A.; Karasev, S.P.; Fedorova, V.V. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1987. 5p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701195/JAW.

Software and hardware for measuring stereography on event semiautomatic measuring device and semiautomatic decoder, entering the measuring multicomputer complex for sterotracks processing are described. Programs are designed for input-output inquiry processing, error processing, loads of working programs to "Ehlektronika-60" computer by operator choice and provide information express-processing. The set of programs is described in MACRO-ASSEMBLER and R-MACRO languages and takes 51 kbytes of disc memory. 4 refs.; 3 figs.

23984 **(KIYI—86-11) Organization of information exchange in a system of the collective usage for the automation of nuclear-physical researches.** Ofengenden, R.G.; Berezin, F.N.; Kisurin, V.A. (AN Ukrainskoj SSR, Kiev. Inst. Yadernykh Issledovanij). 1987. 21p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701199/JAW.

A problem of information exchange is discussed in a system for the collective usage assigned to the automation of experimental investigations at nuclear-physical setups of the Institute for Nuclear Research, the Ukrainian Academy of Sciences. The structure of hardware and software for multi-computer cooperation, the principles based upon the working out of the equipment and software are examined. An organization of information exchange in a system of the collective usage for the automation of nuclear-physical researches. 4 refs.; 3 figs.

23985 **(KIYI—86-15) Software for the construction of multi-computer systems in OS RT-11.** Maznyj, I.A.; Ofengenden, R.G.; Patlan', Yu.V. (AN Ukrainskoj SSR, Kiev. Inst. Yadernykh Issledovanij). 1987. 19p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701200/JAW.

The data transfer protocols and the structure of software at the construction of multi-computer systems in RT-11 operational system are described. The data necessary for a work with a system are given. 8 refs.; 2 figs.

23986 **(LA-UR—87-4255) Rapid prototyping of simulations in artificial intelligence environments.** Martinez, R. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 8p. (CONF-880455—3). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004295/JAW.

From Conference of the Society of Computer Simulation; Orlando, FL, USA (18 Apr 1988).

The benefits derived from rapidly constructing a prototypical simulation model for use in characterizing the scope of a project should not be underestimated. The initial period of contact with the end-user of a simulation will establish the 'ground-rules' by which the project will progress. This paper describes some experiences in the application of an expert system shell in the development of knowledge-based discrete event simulations. This model development approach leverages the benefits of object-oriented programming, frames for representing the objects to be simulated, and the graphics capabilities inherent within many expert system shells. The user interface relies heavily upon the use of graphical active images for the modification of important object attributes prior to runtime. Having a functional knowledge-based simulation facilitates the process of accurately determining the needs of the client.

23987 **(LA-UR—87-4256) Discrete event simulation in the artificial intelligence environment.** Egdorf, H.W.; Roberts, D.J. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 8p. (CONF-880455—4). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004296/JAW.

From Conference of the Society of Computer Simulation; Orlando, FL, USA (18 Apr 1988).

Discrete Event Simulations performed in an Artificial Intelligence (AI) environment provide benefits in two major areas. The productivity provided by Object Oriented Programming, Rule Based Programming, and AI development environments allows simulations to be developed and maintained more efficiently than conventional environments allow. Secondly, the use of AI techniques allows direct simulation of human decision making processes and Command and Control aspects of a system under study. An introduction to AI techniques is presented. Two discrete event simulations produced in these environments are described. Finally, a software engineering methodology is discussed that allows simulations to be designed for use in these environments. 3 figs.

23988 **(LBL—24334) Very large vortex calculations in two dimensions.** Baden, S.B. (Lawrence Berkeley Lab., CA (USA)). Nov 1987. Contract AC03-76SF00098. 28p. (CONF-8705256—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005748/JAW.

From UCLA workshop on vortex methods; Los Angeles, CA, USA (20 May 1987).

We describe an implementation of Anderson's Method of Local Corrections running on the Cray X-MP multiprocessor with 4 CPUs. We will show how the code was vectorized and parallelized, including dynamic load balancing. We present computational results from very large runs of up to 25702 vortices. 15 refs., 7 figs., 5 tabs.

23989 **(N—88-14633) Optimal pre-scheduling of problem remappings. Final report: Sigmetrics conference.** Nicol, D.M.; Saltz, J.H. (National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center). Sep 1987. 26p. (NASA-CR—178378; ICASE—87-52; NAS—1.26:178378). NTIS, PC A03/MF A01.

A large class of scientific computational problems can be characterized as a sequence of steps where a significant amount of computation occurs each step, but the work performed at each step is not necessarily identical. Two good examples of this type of computation are: (1) regridding methods which change the problem discretization during the course of the computation, and (2) methods for solving sparse triangular systems of linear equations. Recent work has investigated a means of mapping such computations onto parallel processors; the method defines a family of static mappings with differing degrees of importance placed on the conflicting goals of good load balance and low communication/synchronization overhead. The performance tradeoffs are controllable by adjusting the parameters of the mapping method. To achieve good performance it may be necessary to dynamically change these parameters at run-time, but such changes can impose additional costs. If the computation's behavior can be determined prior to its execution, it can be possible to construct an optimal parameter schedule using a low-order-polynomial-time dynamic programming algorithm. Since the latter can be expensive, the performance is studied of the effect of a linear-time scheduling heuristic on one of the model problems, and it is shown to be effective and nearly optimal.

23990 **(N—88-14662) Parallel pivoting combined with parallel reduction. Final report.** Alaghband, G. (National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center). Dec 1987. 41p. (NASA-CR—178422; ICASE—87-75; NAS—1.26:178422). NTIS, PC A03/MF A01.

Parallel algorithms for triangularization of large, sparse, and unsymmetric matrices are presented. The method combines the parallel reduction with a new parallel pivoting technique, control over generations of fill-ins and a check for numerical stability, all done in parallel with the work being distributed over the active processes. The parallel technique uses the compatibility relation between pivots to identify parallel pivot candidates and uses the Markowitz number of pivots to minimize fill-in. This technique is not a preordering of the sparse matrix and is applied dynamically as the decomposition proceeds.

23991 (N—88-14874, pp vp) **Fault-tolerant computer architecture based on INMOS transputer processor.** Ortiz, J.L. Nov 1987. NTIS, PC A15/MF A01. (NASA-CR—172009-VOL-2; NAS—1.26:172009-VOL-2).

In National Aeronautics and Space Administration (NASA)/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1987. Volume 2.

Redundant processing was used for several years in mission flight systems. In these systems, more than one processor performs the same task at the same time but only one processor is actually in real use. A fault-tolerance computer architecture based on the fea-

tures provided by INMOS Transputers is presented. The Transputer architecture provides several communication links that allow data and command communication with other Transputers without the use of a bus. Additionally the Transputer allows the use of parallel processing to increase the system speed considerably. The processor architecture consists of three processors working in parallel keeping all the processors at the same operational level but only one processor is in real control of the process. The design allows each Transputer to perform a test to the other two Transputers and report the operating condition of the neighboring processors. A graphic display was developed to facilitate the identification of any problem by the user.

23992 **(ORNL/DSRD—7) Abridged proceedings of the conference on expert systems technology in the ADP environment.** Phifer, M.S.; Allen, S.J.; Emrich, M.L.; Sadlowe, A.R.; Jones, K.A.; Arrowood, L.F. (eds.). (Oak Ridge National Lab., TN (USA)). Nov 1987. Contract AC05-84OR21400. 59p. (CONF-871128—Absts.). NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88006057/JAW.

From NARDAC Washington/ORNL/DSRD conference on expert systems technology in the ADP environment; Washington, DC, USA (2 Nov 1987).

This paper contains abstracts from the conference on Expert Systems Technology in the ADP Environment. The four main topic areas of these papers are: artifical intelligence (AI) in information and software engineering; intelligent databases; AI for decision making; and intelligent human-machine interfaces. (LSP)

23993 **(PB—88-126859/XAB) Strategies in HYDRA (Hypothesis Deduction Through Rule Application), a real-time parallel expert system.** van den Herik, H.J.; Henseler, J.; Verhoest, C.R.J. (Technische Hogeschool Delft (Netherlands). Onderafdeling der Wiskunde en Informatica). 1987. 14p. (REPT—87-34). NTIS, PC E03/MF A01.

In connection with large rule bases and real-time processing of information, parallel expert systems form an important field of research. In an agenda-driven expert system, both forward and backward reasoning may occur, depending on the strategy. Still, it may happen that irrelevant parts of the search space are searched (staggering effects). Seemingly attractive possibilities, so-called phantoms, give rise to the effect. In order to discover and fight phantoms, a ghostbusting strategy is introduced. In HYDRA (Hypothesis Deduction through Rule Application) forward and backward reasoning can be combined thanks to a well-chosen priority function. In the paper, conventional search techniques, supported by the above-mentioned strategies, are compared with reference to some results. These results turn out not to be substantially improved by the addition of a common heuristic.

23994 **(PB—88-132956/XAB) Calculus for network delays and a note on topologies of interconnection networks. Doctoral thesis.** Cruz, R.L. (Illinois Univ., Urbana (USA). Coordinated Science Lab.). Jul 1987. 105p. (UILU-ENG—87-2246). NTIS, PC A06/MF A01.

A calculus is developed for obtaining bounds on delay in a buffered communication network that applies to a wide variety of models for network operation. The theory developed is different from traditional approaches to analyzing delay because the model used to describe the entry of data into the network is non-probabilistic. It is assumed that the data stream entered into the network by any given user satisfies burstiness constraints--that is, the quantity of data from the stream contained in any interval of time is less than a value that depends on the length of the interval. Given this model, it is shown that data traffic streams on each internal link of the network satisfy burstiness constraints. This allows attainment of upper bounds on network delay and buffering requirements. A mechanism called regulation is studied for enforcing burstiness constraints on an arbitrary data stream. The effect of employing these regulation mechanisms inside the network is noted. Theoretical design issues for topologies of interconnection networks are examined.

23995 **(PB—88-857081/XAB) Supercomputers. December 1985-January 1988 (citations from the INSPEC: Information Services for the Physics and Engineering Communities data base). Report for December 1985-January 1988.** (National Technical Information Service, Springfield, VA (USA)). Jan 1988. 231p. NTIS PC N01/MF N01.

Supersedes PB—87-851598.

This bibliography contains citations concerning the development and utilization of supercomputers. The citations include references to algorithms for specific applications and machines, architecture considerations, and problem-solving applications using these very fast computers. Machine development in the U.S. and foreign countries is discussed. (This updated bibliography contains 434 citations, 243 of which are new entries to the previous edition.)

23996 **(SAND—87-2617) SANDAC V programmer's reference manual.** Borgman, C.R. (ed.). (Sandia National Labs., Albuquerque, NM (USA)). Nov 1987. Contract AC04-76DP00789. 211p. NTIS, PC A10/MF A01; 1; GPO Dep. Order Number DE88004639/JAW.

This manual describes from a programmer's viewpoint the SANDAC V embedded computer designed and built at Sandia National Labs. System information is given in sufficient detail to allow a systems programmer to add to or replace software for SANDAC V. 29 figs., 20 tabs.

23997 **(SAND—87-2754) User's guide for HOST33.** Wiegandt, K.E.; Rios, M.A. (Sandia National Labs., Albuquerque, NM (USA)). Jan 1988. Contract AC04-76DP00789. 43p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006217/JAW.

This document describes the use and operation of HOST33, an application independent computer program for translating the primitive component placements of an Applicon AGS/870 drawing file into plot commands suitable for controlling the Gerber Scientific Instrument Company's series 4400 Graphical Display Systems. Readers are assumed to have some familiarity with both the Applicon Graphic System and Gerber photo-plotting operations at Sandia National Laboratories. 12 refs.

23998 **(Y/DW—770) An expert system for assessing the relative importance of maintenance work requests.** Davenport, C.M.; Hopper, L.E. (Oak Ridge Y-12 Plant, TN (USA)). 4 Jan 1988. Contract AC05-84OS21400. 14p. (CONF-880460—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005183/JAW.

From American Production and Inventory Control Society, Inc. (APICS') logistics conference; Dallas, TX, USA (11 Apr 1988).

This paper presents the methods, procedures, and structure of a knowledge-based artificial intelligence (AI) program, called the Maintenance Priority Generator (MPG), for assessing the relative productive importance of maintenance work requests in a large discrete parts manufacturing facility. The objective is to aid the allocation of limited maintenance resources in accordance with the plant mission and stated policies regarding environmental, safety, security, and other issues. The program takes input from the maintenance workorder database, applies expert system technology to generate relative importance numbers, and puts the numbers back into the database. Subsequently, an individual maintenance foreman's work pending list can be printed out in importance order. The program is not meant to be a scheduler because it does not have access to resource availability data, but could provide very useful input to a scheduler program.

23999 **Numerical treatment of a boundary-value problem for a certain singular parabolic partial differential equation.** Spigler, R. (Courant Institute of Mathematical Sciences, New York University, New York, New York 10012). *Journal of Computational Physics;* **74**: No. 1, 233-243(Jan 1988).

We solve a boundary-value problem for a certain linear singular partial differential equation of parabolic type by a suitable implicit finite-difference scheme. This allows us to obtain precise tabulated values for the mean powers reflected and transmitted by a

slab of random medium. This is relevant, e.g., to Plasma Physics. copyright 1988 Academic Press, Inc.

24000 **Numerical simulation for certain stochastic ordinary differential equations.** Spigler, R. (Courant Institute of Mathematical Sciences, New York University, New York, New York 10012). *Journal of Computational Physics;* **74**: No. 1, 244-262(Jan 1988).

A Monte Carlo simulation approach is presented for solving two problems based on stochastic ordinary differential equations, namely an initial-value problem for a nonlinear ordinary differential equation and a two-point boundary-value problem for a linear equation. The method consists of simulating on the computer several realizations of the random process which appears in the coefficients of the equations, and then computing the average over the corresponding solutions. Since these two problems are related to the same physical problem, we are able to compare the results. Several plots are given to illustrate the results and a discussion of the various kinds of errors which affect the method is presented. copyright 1988 Academic Press, Inc.

24001 **Preconditioning technique for indefinite systems resulting from mixed approximations of elliptic problems.** Bramble, J.H.; Pasciak, J.E. (Wave Propagation Laboratory, Environmental Research Laboratories, National Oceanic and Atmospheric Administration, Boulder, Colorado 80303). *Mathematics of Computation;* **50**: No. 181, 1-18(Jan 1988).

This paper provides a preconditioned iterative technique for the solution of saddle point problems. These problems typically arise in the numerical approximation of partial differential equations by Lagrange multiplier techniques and/or mixed methods. The saddle point problem is reformulated as a symmetric positive definite system, which is then solved by conjugate gradient iteration. Applications to the equations of elasticity and Stokes are discussed and the results of numerical experiments are given.

24002 **Hybrid algorithm for solving sparse nonlinear systems of equations.** Dennis J.E. Jr.; Li, G. (Computer Center, Jilin University, People's Republic of China). *Mathematics of Computation;* **50**: No. 181, 155-166(Jan 1988).

This paper presents a hybrid algorithm for solving sparse nonlinear systems of equations. The algorithm is based on dividing the columns of the Jacobian into two parts and using different algorithms on each part. The hybrid algorithm incorporates advantages of both component algorithms by exploiting the special structure of the Jacobian to obtain a good approximation to the Jacobian, using as little effort as possible. A Kantorovich-type analysis and a locally q-superlinear convergence result for this algorithm are given.

24003 **Guided self-scheduling: A practical scheduling scheme for parallel supercomputers.** Polychronopoulos, C.D.; Kuck, D.J. (Center for Supercomputing Research and Development, Univ. of Illinois at Urbana-Champaign, Urbana, IL 61801). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Computers;* **C-36**: No. 12, 1425-1439(Dec 1987).

This paper proposes guided self-scheduling, a new approach for scheduling arbitrarily nested parallel program loops on shared memory multiprocessor systems. Utilizing loop parallelism is clearly most crucial in achieving high system and program performance. This method achieves simultaneously the two most important objectives: load balancing and very low synchronization overhead. For certain types of loops the authors show analytically that guided self-scheduling uses minimal overhead and achieved optimal schedules. The authors discuss experimental results that clearly show the advantage of guided self-scheduling over the most widely known dynamic methods.

24004 **Matrix operations on a multicomputer system with switchable main memory modules and dynamic control.** Su, S.Y.W.; Thakore, A.K. (Database Systems Research and Development Center, Univ. of Florida, Gainesville, FL 32611). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Computers;* **C-36**: No. 12, 1467-1484(Dec 1987).

This paper presents an analysis and evaluation of the performance of a multicomputer system (SM3) in supporting two basic matrix operations, namely multiplication and inversion. The system supports the efficient execution of the above mentioned operations by 1) achieving a high-bandwidth data transfer among computers by switching main memory modules, 2) supporting network partitioning, 3) employing a hardware communication and synchronization scheme, 4) using a distributed control technique, and 5) providing means to dynamically transfer control. Timing equations are derived and evaluated in an attempt to analyze the performance. Different cases which arise due to the relative sizes of memory modules and matrices during matrix multiplication are analyzed. The cases of partial and maximal pivoting during inversion are also analyzed. The SM3 system is compared quantitatively and qualitatively to a hypercube architecture.

24005 **Compiler algorithms for synchronization.** Midkiff, S.P.; Padua, D.A. (Center for Supercomputing Research and Development, Univ. of Illinois at Urbana-Champaign, Urbana, IL 61801). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Computers;* **C-36**: No. 12, 1485-1495(Dec 1987).

Translating program loops into a parallel form is one of the most important transformations performed by concurrentizing compilers. This transformation often requires the insertion of synchronization instructions within the body of the concurrent loop. Several loop synchronization techniques are presented first. Compiler algorithms to generate synchronization instructions for singly-nested loops are then discussed. Finally, a technique for the elimination of redundant synchronization instructions is presented.

24006 **A multi-process user interface.** Petravick, D.; Constanta-Fanourakis, P.; White, V. (Data Acquisition Software Group, Fermi National Accelerator Lab., M.S. 120, Batavia, IL 60510). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-34**: No. 4, 937-940(Aug 1987). (CONF-870552—). Contract AC02-76CH03000.

From 5. conference on real-time computer applications in nuclear, particle, and plasma physics; San Francisco, CA, USA (12 May 1987).

MENCOM and GLOBAL MENU provide solutions for software engineering problems encountered while implementing VAX/VMS based data acquisition systems at Fermilab. Taken together, this software provides a programming philosophy that is consistent with the needs of both experimenters and DAQ group staff. MENCOM provides a user interface for developing or debugging programs 'standalone'. The very same program may then, without even re-linking, be incorporated into a larger system of many processes, governed by the GLOBAL MENU program.

24007 **Software for the Fermilab Smart Crate Controller.** Bernett, M.; Calvo, O.; Wickert, S. (Fermi National Accelerator Lab., P.O. Box 500, Batavia, IL 60510). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-34**: No. 4, 1047-1049(Aug 1987). (CONF-870552—). Contract AC02-76CH03000.

From 5. conference on real-time computer applications in nuclear, particle, and plasma physics; San Francisco, CA, USA (12 May 1987).

This reports on the software that has been developed to support the Fermilab Smart Crate Controller. This includes a monitor, a readout list support package, a VAX based loader and communication program, IEEE CAMAC subroutine library support, and diagnostic software.

24008 **A software package for the analysis of general multilayer performance data.** Peterson, B.G.; Pew, H.K.; Knight, L.V.; Gaines, D.P. (Brigham Young Univ., Provo, UT). pp 405-409 of Soft x-ray optics and technology. Koch, E.E.; Schmahl, G. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-861242—).

From International conference on soft X-ray optics and technology; West Berlin, F.R. Germany (8 Dec 1986).

In an effort to make data on the reflectivity and transmission of multilayer optical elements more unstable, the authors developed a computer code for the manipulation and graphical display of a general data set consisting of x, y, and delta-y values. The code was developed for a DEC VAX computer running a version 4.2 or later VMS operating system. Facilities are available for algebraic manipulation, editing, smoothing, interpolating, and deconvolving data sets in a straightforward way. The code is entirely self-contained with the exception of the graphics output support, which is centralized to allow for simple interfacing to the graphics package resident on the target system. The capabilities of the code are described and sample output is shown.

24009 **Expert system for Fastbus diagnosis.** Booth, A.W.; Carroll, J.T. (Fermi National Accelerator Lab., Batavia, IL). pp 67-76 of Computing in high energy physics. Ash, W. (ed.). Amsterdam, The Netherlands; North-Holland Physics Publishing (1987).

From Computing high energy physics; Pacific Grove, CA, USA (2 Feb 1987).

The complexity of the FASTBUS network at CDF makes access to expert assistance a necessity for efficient operation. A software Expert System has been proposed to diagnose FASTBUS errors and advise users on recovery options in the interactive DAQ environment. This paper introduces some basic features of rule-based programming and uses examples to describe how expert systems function. A prototype system, FBEXPERT, has been developed using a language called OPS5 and applied to the diagnosis of a network problem. This paper includes an example which shows how the system updates its knowledge base as it proceeds to the correct solution. 13 references, 3 figures.

24010 **Analysis of network statistics.** Cottrell, R.L.A. pp 93-109 of Computing in high energy physics. Ash, W. (ed.). Amsterdam, The Netherlands; North-Holland Physics Publishing (1987).

From Computing high energy physics; Pacific Grove, CA, USA (2 Feb 1987).

This talk discusses the types and sources of data obtainable from networks of computer systems and terminals connected by communications paths. These paths often utilize mixtures of protocols and devices (such as modems, multiplexors, switches and front-ends) from multiple vendors. The talk describes how the data can be gathered from these devices and protocol layers, consolidated, stored, and analyzed. The analysis typically includes merging information from data bases describing the network topology, components, etc. Examples of reports and displays of the information gleaned are shown, together with illustrations of how the information may be useful for troubleshooting, performance measurement, auditing, accounting, and trend prediction. 8 references, 16 figures, 2 tables.

24011 **NSF National Computing Centers: past, present, and future.** Brandt, L.E. (National Science Foundation, Washington, DC). pp 147-148 of Computing in high energy physics. Ash, W. (ed.). Amsterdam, The Netherlands; North-Holland Physics Publishing (1987).

From Computing high energy physics; Pacific Grove, CA, USA (2 Feb 1987).

Several years ago, the National Science Foundations, a US Government agency, began a program to provide for US researchers access to the world's most advanced computers. Five national computing centers have been established, and are serving over 6000 researchers from all parts of the country. Regular hardware and software improvements will keep these centers at the cutting edge of computer technology. Along with the national centers, NSF is building a national academic research network, called NSFNET, which will soon connect scientists and engineers at over 200 institutions.

24012 **Introduction to real-time graphical techniques for analyzing multivariate data.** Friedman, J.H.; McDonald, J.A.; Stuetzle, W. (Stanford Univ., CA). pp 161-167 of Computing in high energy physics. Ash, W. (ed.). Amsterdam, The Netherlands; North-Holland Physics Publishing (1987).

From Computing high energy physics; Pacific Grove, CA, USA (2 Feb 1987).

Orion I is a graphics system used to study applications of computer graphics - especially interactive motion graphics - in statistics. Orion I is the newest of a family of PRIM systems, whose most striking common feature is the use of real-time motion graphics to display three dimensional scatterplots. Orion I differs from earlier Prim systems through the use of modern and relatively inexpensive raster graphics and microprocessor technology. It also delivers more computing power to its user; Orion I can perform more sophisticated real-time computations than were possible on previous such systems. They demonstrate some of Orion I's capabilities in their film: Exploring data with Orion I. 12 references.

24013 **Solids modeling and rendering on workstations - a pictorial overview.** van Dam, A. (Brown Univ., Providence, RI). pp 169-174 of Computing in high energy physics. Ash, W. (ed.). Amsterdam, The Netherlands; North-Holland Physics Publishing (1987).

From Computing high energy physics; Pacific Grove, CA, USA (2 Feb 1987).

Realistic and pseudo-realistic images will quickly displace wire frame representation for real-time modeling in many situations in science and engineering, now that the amount of computing power can be dramatically increased due to the migration of supercomputing power to personal workstations. This will be achieved with a combination of improvements in CPU and display processor architecture, thanks to (semi-)custom VLSI designs. New applications, especially in 3D M-CAD and high-end science and engineering, will benefit greatly from this new interactive compute-and-visualize capability. 15 figures.

24014 **Personal computers in high energy physics.** Quarrie, D.R. (Fermilab, Batavia, IL). pp 175-179 of Computing in high energy physics. Ash, W. (ed.). Amsterdam, The Netherlands; North-Holland Physics Publishing (1987).

From Computing high energy physics; Pacific Grove, CA, USA (2 Feb 1987).

The role of Personal Computers within HEP is expanding as their capabilities increase and their cost decreases. Already they offer great flexibility than many low-cost graphics terminals for a comparable cost and in addition they can significantly increase the productivity of physicists and programmers. This talk will discuss existing uses for Personal Computers and explore possible future directions for their integration into the overall computing environment. 2 figures.

24015 **DELPHI interactive analysis and TANAGRA.** Bertrand, D. (Inter Univ. Institute for High energies, Brussels, Belgium). pp 207-213 of Computing in high energy physics. Ash, W. (ed.). Amsterdam, The Netherlands; North-Holland Physics Publishing (1987).

From Computing high energy physics; Pacific Grove, CA, USA (2 Feb 1987).

The DELPHI interactive data analysis must, with regard to its complexity, be structured in a modular way. Each module is as far as possible independent of the others limiting the contact to the data transmission. The coherence of the program is insured by the data structure itself, only accessible through a buffer processor TANAGRA protecting it. The command processor ICI allows to perform the data analysis in an asynchronous way, which is indispensable to the permanent adjustment of the logic to the complex behavior of the multifunctional detector DELPHI. The TANAGRA package keeps the history of the events allowing a complete remake of the procedure at any moment. 8 references, 2 figures, 1 table.

24016 **Managing large scale projects: some simple principles for developing complex systems.** Manzo, J. (Digital Equipment Corp.). pp 215-228 of Computing in high energy physics. Ash, W. (ed.). Amsterdam, The Netherlands; North-Holland Physics Publishing (1987).

From Computing high energy physics; Pacific Grove, CA, USA (2 Feb 1987).

Rapidly changing technologies, increased competitive and environmental pressures, and more complex organizational missions

have placed enormous challenges on today's software and hardware systems developers to produce their systems in a timely and cost effective manner. Regrettably, in their haste to respond to this challenge, they have tended to focus more on symptoms than causes. The results have generally been unsatisfying, producing a set of often complicated, impractical, and sometimes disappointing or even unsatisfactory development methods and tools. The nature of complexity is examined in the context of the hurdles faced by the developers of more sophisticated and higher performing computer-based systems. The pathological effects of complexity on system development are explored through a general model. With this discussion as a basis, they adduce a set of simple principles and offer examples of development methods from the aerospace and computer industries, which have proven highly effective in managing system development at the complexity frontier. 14 references, 14 figures.

24017 **Fortran 8x - the emerging standard.** Metcalf, M. (CERN, Geneva, Switzerland). pp 259-268 of Computing in high energy physics. Ash, W. (ed.). Amsterdam, The Netherlands; North-Holland Physics Publishing (1987).

From Computing high energy physics; Pacific Grove, CA, USA (2 Feb 1987).

Since 1979, the Fortran standardization committee, X3J3, has been laboring over a draft for the next version of the standard. Its initial intention of publishing this draft in 1982 was hopelessly optimistic, and at best it may be ready this year. However, a number of fundamental issues have been thrown up over the past two years, such that it is clear that unanimity cannot be achieved: efficiency versus functionality; safety versus obsolescence; small and simple or big and powerful? This paper reviews the current state and content of Fortran 8x, and attempts to bring out some of the controversial issues surrounding its development. 4 references, 3 figures.

24018 **Static allocation in parallel computers.** Maturana, G. (Boston Univ., MA). pp 319-322 of Computing in high energy physics. Ash, W. (ed.). Amsterdam, The Netherlands; North-Holland Physics Publishing (1987).

From Computing high energy physics; Pacific Grove, CA, USA (2 Feb 1987).

In this paper they present the statistical mechanical treatment of an optimization problem related to static allocation in massively parallel computers. They show that there is a strong relation between this problem and the Sherrington-Kirkpatrick model for spin glasses. This analogy makes it likely that the space of solutions shows an ultrametric structure. The significance of the results to parallel processing is discussed, and particular emphasis is given to the complexity of finding the optimal allocation. They discuss directions for further research in this novel area. 12 references.

24019 **Low cost scientific video movie making.** Johnston, W.E.; Hall, D.E.; Renema, F.; Robertson, D. (Lawrence Berkeley Lab., CA). pp 479-484 of Computing in high energy physics. Ash, W. (ed.). Amsterdam, The Netherlands; North-Holland Physics Publishing (1987). Contract AC03-76SF00098.

From Computing high energy physics; Pacific Grove, CA, USA (2 Feb 1987).

A low cost video movie making system is described. The system consists of a PC microcomputer based animation controller, video frame buffer, and 1/2" editing video tape recorder. The graphic data typically generated on mainframe computers is transferred over a local area network to the PC, there to be recorded, one frame at a time, to produce a video tape movie. The characteristics and limitations of the system are discussed, together with implications of encoding graphic primitives in an NTSC video signal. The use of the system for scientific movie making is described. 4 references, 1 figure, 2 tables.

24020 **Implementation of multigrid algorithms on hypercubes.** Chan, T.F.; Tuminaro, R.S. (Dept. of Mathematics, Univ. of California, Los Angeles, CA 90024). pp 730-737 of Hypercube multiprocessors 1987. Heath, M.T. Philadelphia, PA; Society for Industrial and Applied Mathematics (1987). (CONF-8609173—).

From 2. conference on hypercube multiprocessors; Knoxville, TN, USA (29 Sep 1986).

The authors discuss the implementation of multigrid algorithms for the solution of partial differential equations on a hypercube multiprocessor. The authors show how the topology of the hypercube fits the data flow of the multigrid algorithm, and therefore allows efficient parallel implementations. The authors present a timing model for the execution time which predicts accurately experimental results obtained from runs on an Intel iPSC system.

24021 **Numerical computation on massively parallel hypercubes.** McBryan, O.A. (Courant Institute, 251 Mercer Street, New York, NY 10012). pp 706-719 of Hypercube multiprocessors 1987. Heath, M.T. Philadelphia, PA; Society for Industrial and Applied Mathematics (1987). (CONF-8609173—).

From 2. conference on hypercube multiprocessors; Knoxville, TN, USA (29 Sep 1986).

The authors describe numerical computations on the Connection Machine, a massively parallel hypercube architecture with 65,536 single-bit processors and 32 Mbytes of memory. A parallel extension of COMMON LISP, provides access to the processors and network. The rich software environment is further enhanced by a powerful virtual processor capability, which extends the degree of fine-grained parallelism beyond 1,000,000. The authors briefly describe the hardware and indicate the principal features of the parallel programming environment. They then present implementations of SOR, multigrid and pre-conditioned conjugate gradient algorithms for solving partial differential equations on the Connection Machine. Despite the lack of floating point hardware, computation rates above 100 megaflops have been achieved in PDE solution. Virtual processors prove to be a real advantage, easing the effort of software development while improving system performance significantly. The software development effort is also facilitated by the fact that hypercube communications prove to be fast and essentially independent of distance.

24022 **The SSOR preconditioned conjugate gradient on a hypercube.** Vaughan, C.T.; Ortega, J.M. (Dept. of Applied Mathematics, Univ. of Virginia, Charlottesville, VA 22901). pp 692-705 of Hypercube multiprocessors 1987. Heath, M.T. Philadelphia, PA; Society for Industrial and Applied Mathematics (1987). (CONF-8609173—).

From 2. conference on hypercube multiprocessors; Knoxville, TN, USA (29 Sep 1986).

This paper gives model and computational results for SSOR preconditioned conjugate gradient on a 64 processor Intel iPSC. Results for conjugate gradient and SOR are also given. All three methods are applied to two model problems: a Poisson-like equation with a mixed derivative term and a plane stress problem.

24023 **Solving finite element problems with parallel multifrontal schemes.** Geist, G.A. (Oak Ridge National Lab.). pp 656-661 of Hypercube multiprocessors 1987. Heath, M.T. Philadelphia, PA; Society for Industrial and Applied Mathematics (1987). (CONF-8609173—).

From 2. conference on hypercube multiprocessors; Knoxville, TN, USA (29 Sep 1986).

A parallel multifrontal scheme is presented that uses a method the authors call the super boundary element technique. This technique reduces the amount of communication required during the factorization to log/sub 2/(rho) sends, where rho is the number of processors. Furthermore, no communication is required in the parallel back substitution using this technique. A finite element fracture analysis problem is used to illustrate this method. Results from this small problem show a decrease in execution time of 58% while larger problems are expected to have even better improvements.

24024 **A divide and conquer algorithm for the unitary eigenproblem.** Gragg, W.B.; Reichel, L. (Dept. of Mathematics, Univ. of Kentucky, Lexington, KY 40506). pp 639-650 of Hypercube multiprocessors 1987. Heath, M.T. Philadelphia, PA; Society for Industrial and Applied Mathematics (1987). (CONF-8609173—).

From 2. conference on hypercube multiprocessors; Knoxville, TN, USA (29 Sep 1986).

In divide and conquer methods for eigenproblems, the original problem is split into several smaller subproblems by using rank one modifications of the matrix. This approach has been shown to be efficient for the symmetric eigenproblem, in particular, when implemented on a parallel computer. The present paper describes a divide and conquer method for the eigenproblem for unitary matrices.

24025 **Fast parallel algorithms for the Moore-Penrose pseudo-inverse.** Benson, M.W.; Frederickson, P.O. (Dept. of Mathematical Sciences, Lakehead Univ., Thunder Bay). pp 597-604 of Hypercube multiprocessors 1987. Heath, M.T. Philadelphia, PA; Society for Industrial and Applied Mathematics (1987). (CONF-8609173—).

From 2. conference on hypercube multiprocessors; Knoxville, TN, USA (29 Sep 1986).

The authors employ the concept of an approximate pseudo-inverse (API) of a singular linear operator A to construct algorithms that yield the Moore-Penrose pseudo-inverse solution chi/sup +/ = A/sup +/y to the singular system Achi = y. Such an algorithm is a nonmatrix representation of the Moore-Penrose pseudo-inverse A/sup +/ of A. The authors are particularly interested in fast algorithms [executable in O(n) operations] that are fully efficient on parallel computers. One result presented concerns the construction of APIs for consistent problems and is applied to the two-dimensional free-boundary spline interpolation problem. For this problem, the conjugate gradient algorithm, preconditioned with an API, proves to be very effective. The V-cycle multigrid algorithm FAPIN is shown to be an API if the smoother satisfies a certain condition and proves to be very effective for Poisson's problem on a two-torus. They have demonstrated their algorithms for n close to one million on the iPSC hypercube at Christian Michelsen Institute, Bergen.

24026 **A parallel triangular solver for a hypercube multiprocessor.** Li, G.; Coleman, T.F. (Computer Science Dept. and Center for Applied Mathematics, Cornell Univ., Ithaca, NY 14853). pp 539-551 of Hypercube multiprocessors 1987. Heath, M.T. Philadelphia, PA; Society for Industrial and Applied Mathematics (1987). (CONF-8609173—).

From 2. conference on hypercube multiprocessors; Knoxville, TN, USA (29 Sep 1986).

The authors consider solving triangular systems of linear equations on a hypercube multiprocessor. Specifically, they propose a fast parallel algorithm, applicable when the triangular matrix is distributed around the cube by column in a wrap fashion. Numerical experiments indicate that the new algorithm is very efficient. A theoretical analysis confirms that the total running time varies linearly, with respect to the matrix order, up to a threshold value of the matrix order, after which the dependence is quadratic.

24027 **The Caltech concurrent computation program.** Fox, G.C. (Concurrent Computation Program, California Institute of Technology, Pasadena, CA 91125). pp 353-381 of Hypercube multiprocessors 1987. Heath, M.T. Philadelphia, PA; Society for Industrial and Applied Mathematics (1987). (CONF-8609173—).

From 2. conference on hypercube multiprocessors; Knoxville, TN, USA (29 Sep 1986).

This report describes the current status of the Caltech Concurrent Computation Program (C/sup 3/P), which is a major effort at both the Caltech campus and JPL (Jet Propulsion Laboratory). The major goal of the program is to develop the capability of concurrent processors for general purpose computation with special emphasis on science and engineering. An important feature of the approach is that the members of the project are scientists who lead in the use of computational techniques in their respective research fields, and have already developed state-of-the-art programs on sequential machines. These scientists are motivated to implement problems on concurrent processors because such machines have been demonstrated to be effective computational tools, and capable of solving major computing intensive problems. A further incentive is that the authors are developing computers whose (hypercube) architectures "scale" to a large number of nodes and, consequently, to much greater computational power than any sequential machines. One advantage of this approach is that they are motivated both to develop efficient ("good") code as well as to implement entire problems. It has been possible to take advantage of advances in computer science and applied mathematics in all three areas of hardware, software and algorithms.

24028 **A portable system for simulating distributed parallel processors on shared memory machines.** Montry, G.R. (Sandia National Labs., Albuquerque, NM 87185). pp 276-284 of Hypercube multiprocessors 1987. Heath, M.T. Philadelphia, PA; Society for Industrial and Applied Mathematics (1987). (CONF-8609173—).

From 2. conference on hypercube multiprocessors; Knoxville, TN, USA (29 Sep 1986).

A package of FORTRAN communications routines has been developed for use on shared memory multiprocessors. The package allows users to define an arbitrary processor interconnect scheme as though they were working on a distributed memory machine. Data which are not shared between processes or processors may be exchanged via a shared pool of circular buffers. The data messages are physically copied from the sending processor to the receiving processor via the buffers. The package is portable among shared memory architectures. The only system-dependent capabilities necessary to implement the package are (1) a method of sharing some common memory between all processors, (2) a method of implementing critical sections of shared code, such as locks, and (3) a method of synchronizing tasks, such as semaphores (optional). The package supports two types of processor-processor communications. The synchronous method, in which cooperating processes must rendezvous in order to exchange data, can be invoked with a single switch. The default method is asynchronous; in which the sending process continues computation without synchronizing with the receiving processor. A complete post-mortem analysis of the communications statistics for each processor is also available. The post-mortem indicates the efficiency of buffer use and the total read-write latency for each of the processors.

24029 **UNMHC: The Los Alamos and University of New Mexico hypercube.** Pollard, H.; Cyrus, T.; Therman, R.; Hong, J.; Kellner, R.; Tomlinson, B. (Univ. of New Mexico, Dept. of Electrical and Computer Engineering). pp 271-275 of Hypercube multiprocessors 1987. Heath, M.T. Philadelphia, PA; Society for Industrial and Applied Mathematics (1987). (CONF-8609173—).

From 2. conference on hypercube multiprocessors; Knoxville, TN, USA (29 Sep 1986).

The University of New Mexico is building a hypercube which has some unique characteristics. Each node consists of a large compute section and an I/O section, each of which use 32000 series microprocessors to provide compute power. The memory available at a node can be 8 MBytes. The I/O section of each node provides network access and disk storage. The links provide high speed interaction between nodes. The system will be operational soon and provide a platform for a number of application areas.

24030 **Switching between interrupt driven and polled communication systems on a hypercube.** Cisneros, A.; Kolawa, A. (Instituto Politecnico Nacional, Mexico. Supported by Comision de Operacion y Fomento de las Actividades Academicas I.P.N. and by Sistema Nacional de Investigadores). pp 239-243 of Hypercube multiprocessors 1987. Heath, M.T. Philadelphia, PA; Society for Industrial and Applied Mathematics (1987). (CONF-8609173—).

From 2. conference on hypercube multiprocessors; Knoxville, TN, USA (29 Sep 1986).

The authors present algorithms to switch between asynchronous and polled communication systems on a hypercube. These algorithms require synchronization routines implemented by message passing on machines without a hardware global line. In switching from asynchronous to polled communications verification that all messages have been received is necessary. The algorithms were implemented on the Caltech/JPL hypercube Mark II model. Timings were taken on the same machine.

24031 Communication algorithms for regular convolutions and matrix problems on the hypercube. Fox, G.C.; Furmanski, W. (Concurrent Computation Program, California Institute of Technology, Pasadena, CA 91125). pp 223-238 of Hypercube multiprocessors 1987. Heath, M.T. Philadelphia, PA; Society for Industrial and Applied Mathematics (1987). (CONF-8609173—).

From 2. conference on hypercube multiprocessors; Knoxville, TN, USA (29 Sep 1986).

The authors describe a set of communication utilities for the hypercube and illustrate their use in several examples involving long distance messages. They present optimal hypercube decompositions for some matrix algorithms, global scalar products, tree decompositions and the binary Fast Fourier Transform.

24032 A comparison of the performance of the Caltech Mark II hypercube and the Elxsi 6400. Walker, D.W.; Fox, G.F.; Ho, A.; Montry, G.R. (Concurrent Computation Project, 206-49, California Institute of Technology, Pasadena, CA 91125). pp 210-222 of Hypercube multiprocessors 1987. Heath, M.T. Philadelphia, PA; Society for Industrial and Applied Mathematics (1987). (CONF-8609173—).

From 2. conference on hypercube multiprocessors; Knoxville, TN, USA (29 Sep 1986).

Previous work has investigated the use of the pre-conditioned, conjugate gradient (pcg) algorithms in solving finite element problems on the multi-processor Elxsi 6400, and has shown how the optimal use of cached and shared memory can result in faster code. In this paper the implementation of the algorithm on both the Caltech hypercube and the Elxsi 6400 are discussed. It was found that on both machines the pcg part of the code runs with efficiency greater than 90% for all problems large enough to be of interest. Sequential code can be ported to a shared memory machine without making algorithmic changes, however, extra coding is required to ensure cache coherency. When porting code to a hypercube it is often necessary to make algorithmic changes. A good implementation of the code discussed here on a shared memory machine would use a hypercube type of algorithm, with software support for hypercube message passing.

24033 Hypercube performance. Dunigan, T.H. (Mathematical Sciences Section, Oak Ridge National Lab., P.O. Box Y, Oak Ridge, TN 37831). pp 178-192 of Hypercube multiprocessors 1987. Heath, M.T. Philadelphia, PA; Society for Industrial and Applied Mathematics (1987). (CONF-8609173—). Contract AC05-84OR21400.

From 2. conference on hypercube multiprocessors; Knoxville, TN, USA (29 Sep 1986).

The performance of three commercially available hypercube parallel processors is analyzed. Computation and communication performance for a number of low-level benchmarks are presented for the Ametek S14 hypercube, the Intel iPSC hypercube, and the Ncube hypercube.

24034 The implementation of a dynamic load balancer. Fox, G.C.; Kolawa, A.; Williams, R. (Concurrent Computation Program, California Institute of Technology, Pasadena, CA 91125). pp 114-121 of Hypercube multiprocessors 1987. Heath, M.T. Philadelphia, PA; Society for Industrial and Applied Mathematics (1987). (CONF-8609173—).

From 2. conference on hypercube multiprocessors; Knoxville, TN, USA (29 Sep 1986).

The authors discuss the issues involved in the implementing of a simple dynamic load balancer on the hypercube. They use the physics analogy introduced by Fox and Jefferson where load balance corresponds to minimizing an appropriate energy function. They specialize to those problems where the user (problem) can estimate the terms in the energy function and specify a user interface to the load balancer. Their methods apply to a wide class of time synchronized simulations.

24035 A graphical tool for observing the behavior of parallel logic programs. Disz, T.; Lusk, E. (Mathematics and Computer Science Dept., Illinois Benedictine College, Lisle, IL 60532). pp 46-53 of Proceedings of the 1987 symposium on logic programming. Piscataway, NJ; IEEE Service Center (1987). (CONF-870899—).

From 4. symposium on logic programming; San Francisco, CA, USA (31 Aug 1987).

The authors describe a graphical tool that has been useful in studying and improving the behavior of parallel logic programs. The parallel logic programming system being studied is ANLWAM, a parallel version of the Warren abstract machine that runs on a variety of shared-memory multiprocessors. The graphical tool, called WAMTRACE, currently runs on Sun workstations. The coupling between the two is not close, and WAMTRACE can easily be interfaced to other parallel systems. The authors describe here the features of the system, and give several examples of how it can be used to improve one's understanding of both a parallel logic program and the system that provides its parallel execution environment.

9903 Information Handling

REFER ALSO TO CITATION(S) 21589, 21948, 23954, 23958, 23994, 24047

24036 (AD-A—186986/6/XAB) Application of a data-base system for inventory management of classified material. Master's thesis. Lim, R.M. (Naval Postgraduate School, Monterey, CA (USA)). Sep 1987. 80p. NTIS, PC A05/MF A01.

The purpose of this study was to develop a data-base system model suitable for implementation onboard Naval ships, and to aid in the inventory management of classified material in this environment. The developed system must be considered a prototype model which may need further modification and extension in order to fit a specific user's need. Although the system must be considered a prototype in its present form, the application program will perform all the basic jobs of the sub-custodian with regard to inventory management. Since dBase III PLUS was used in the application program of this thesis, a relational data base must be used. A brief discussion of relational database model was reviewed in Chapter II, in order to give the user basic knowledge of the model. The system is menu-driven. Not only easy to use but also easy to develop a database modify, since both the user and the programmer are directed to the desired point through the sequence of menus and sub-menus. Finally, it is up to the security manager and secret custodian to monitor the effectiveness of this application program during the initial implementation stage and throughout its life cycle.

24037 (AD-A—187244/9/XAB) Design of the POSTGRES storage system. Technical report. Stonebraker, M. (California Univ., Berkeley (USA). Electronics Research Lab.). 4 Feb 1987. 14p. (UCB/ERL-M—87/6). NTIS, PC A03/MF A01.

This paper presents the design of the storage system for the POSTGRES data base system under construction at Berkeley. It is novel in several ways. First, the storage manager supports transaction management but does so without using a conventional write-ahead log (WAL). In fact, there is no code to run at recovery time and, consequently, recovery from crashes is essentially instantaneous. Second, the storage manager allows a user to optionally keep the entire past history of data-base objects by closely integrating an archival storage system to which historical records are spooled. Lastly, the storage manager is consciously constructed as a collection of asynchronous processes. Hence, a large monolithic body of code is avoided and opportunities for parallelism can be exploited. The paper concludes with a analysis of the storage system which suggests that it is performance competitive with WAL systems in many situations.

24038 (AD-P—005626/7/XAB) Security considerations - defense-related and commercial. Braun, H. (Bundesministerium der Verteidigung, Bonn (Germany, F.R.). Dokumentationszentrum der Bundeswehr). 1987. 11p. NTIS, PC A03/MF A01.

This article is from Planning and Designing Effective Defence and Related Information Services: Conference Proceedings of the Technical Information Panel Specialists Meeting Held in Ankara, Turkey on 10-11 September 1986, AD-A184 833, 6-1-6-11.

This paper addresses a number of topics associated with the management and handling of classified documents and documents

under commercial confidentiality in a defense information center. In case of classified documents, the need-to-know principle governs the procedures. Questions that need answers are: Operate a classified data base or keep the data in it unclassified? How to produce unclassified references to classified documents? Which restrictions have to be observed when using unclassified references to classified documents? The restrictions imposed upon documents with statements limiting their distribution are discussed, the difference between unclassified and unlimited is explained.

24039 **(CONF-870733—15) EMMPDL: An electron microscopy and microanalysis public domain library.** Zaluzec, N.J. (Argonne National Lab., IL (USA)). Aug 1987. Contract W-31109-ENG-38. 8p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88005939/JAW.

From Pacific workshop and meeting on analytical electron microscopy; Kona, HI, USA (12 Jul 1987).

As personal computers become more and more prolific it becomes inevitable that programs and/or generic subroutines useful in both electron microscopy and microanalysis are rewritten or redeveloped a great number of times for a range of different languages and computers. Most microscopists/microanalysts are more than willing to share this information with the general community if there was a reasonable means to distribute it without severely impacting on their own time and/or resources. To this end a public domain software library has been jointly established by the Electron Microscopy Center at Argonne and the Bulletin of the Electron Microscopy Society of America (EMSA). The purpose of this library is to make available to the scientific community public domain software useful to electron microscopists nationwide. Access to this information is completely free of charge and users having PC's, Micro, Mini, or Mainframe computer systems can access the data base for their research using conventional telecommunications protocols.

24040 **(CONF-880348—1) A PROLOG registry of experts.** Ferrada, J.J.; Mashburn, S.A.; Rodgers, B.R. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 22p. NTIS, PC A03. Order Number DE88005911/JAW.

From American Institute of Chemical Engineers spring national meeting; New Orleans, LA, USA (6 Mar 1988).

This paper discusses the use of Prolog in the construction of a user-friendly registry of consultants. This data base provides access by name, expertise, organization, or state. Also discussed are the features of this language which make it adaptable for this purpose. 3 refs., 11 figs. (LSP)

24041 **(ECN—202) Computer programs for calculating group cross-section covariances from uncertainty parameters in the ENDF/B-V format. UNC 32/33.** Nolthenius, H.J. (Netherlands Energy Research Foundation, Petten). Oct 1987. 33p. NTIS (US Sales Only), PC A03/MF A01. Order Number TI88701719/JAW.

Cross-section libraries in the ENDF/B-V format contain uncertainty information for a number of cross-section sets. The programs UNC 32/33 read this information and convert it to a group structure of interest for further calculations. The output of the programs becomes available in the form of a set of covariance matrices. These programs are useful for estimating the role of covariances in the calculation of reaction rates and adjusted neutron spectra, since the programs provide a convenient tool for deriving covariance matrices of cross-sections in a selected coarse group structure directly from libraries in the ENDF/B-V format. 8 refs.; 9 figs.; 6 tables.

24042 **(IFVE-OEIUNK—87-125) PPDS compas-primer.** Alekhin, S.I.; Bazeeva, V.V.; Grudtsin, S.N. and others. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. 40p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number TI88701589/JAW.

Catalogue of IHEP data bases on particle physics (PPDS) and short guide for unexperienced user are presented. All data bases are under common data base management system and include bibliographic and factographic ones. Binary search and set of applied programs controlling input and formatting output make using of system easy and convenient. Basic programs are developed in FORTRAN. 12 refs.

24043 **(INDC(NDS)—198/LFR) Analysis of the REAL-84 intercomparison exercise. Summary of the specialists' meeting held in Jackson Hole, USA, 27-29 May 1987.** (International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee). Oct 1987. 10p. (CONF-8705257—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701451/JAW.

From Specialists' meeting on analysis of the REAL-84 intercomparison exercise; Jackson Hole, WY, USA (27 May 1987).

The document presents the conclusions and the recommendations of the specialists' meeting organized by the IAEA and held in Jackson Hole (USA) between 27-29 May 1987 as a result of the analysis of the REAL-84 intercomparison exercise for improving the accuracy in radiation damage predictions in the neutron environment using good quality input data and proper calculation methods. 6 refs.

24044 **(ORNL/TM—10595) Design specifications for NALDA [Naval Aviation Logistics Data Analysis] CAI [computer aided instruction]: Phase 2, Interim report.** Twitty, A.F.; Handler, B.H.; Duncan, L.D.; Halsey, P.J.; Bryant, R.A.; Shaffer, K.E.; Hallbick, A.M.; Alvaro, D.R. (Martin Marietta Energy Systems, Inc., Oak Ridge, TN (USA)). Dec 1987. Contract AC05-84OR21400. 92p. NTIS, PC A05. Order Number DE88005868/JAW.

Data Systems Engineering Organization (DSEO) personnel are developing a prototype computer aided instruction (CAI) system for the Naval Aviation Logistics Data Analysis (NALDA) system. The objective of this project is to provide a prototype for implementing CAI as an enhancement to existing NALDA training. The CAI prototype project is being performed in phases. The task undertaken in Phase I was to analyze the problem and the alternative solutions and to develop a set of recommendations on how best to proceed. In Phase II a structured design and specification document was completed that will provide the basis for development and implementation of the desired CAI system. Phase III will consist of designing, developing, and testing a user interface which will extend the features of the Phase II prototype. The design of the CAI prototype has followed a rigorous structured analysis based on Yourdon/DeMarco methodology and Information Engineering tools. This document includes data flow diagrams, a data dictionary, process specifications, an entity-relationship diagram, a curriculum description, special function key definitions, and a set of standards developed for the NALDA CAI Prototype.

24045 **(UCID—21201) Hazards Control Department use of the Sperry database management system, MAPPER.** King, W.C. (Lawrence Livermore National Lab., CA (USA)). 19 Oct 1987. Contract W-7405-ENG-48. 21p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88006591/JAW.

The Hazards Control data files are maintained in MAPPER, a Sperry-developed database management system that has been used for many years by Univac users. In its current version, MAPPER is extremely versatile and is considered one of the best fourth generation programs. It contains, in addition to a database management system, a word processor, office automation program including electronic mail, and color graphics routines. All of these routines are available for the IBM PC user employing the PEP program of Computer Logics Ltd. with proper board configuration. Some of the routines of MAPPER listed above will not be available if the user is employing VTERM through the Sytek net or by direct dial-up.

9904 Law

REFER ALSO TO CITATION(S) 23951

24046 **(INIS-XN—113) Agreement between Norway and Sweden on exchange of information and early notification relating to Swedish and Norwegian nuclear facilities etc.** (International Atomic Energy Agency, Vienna (Austria)). 21 Oct 1986. 5p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701096/JAW.

Translated from original Norwegian.

In the context of the adoption of the IAEA Convention on Early Notification of a Nuclear Accident, Norway and Sweden concluded this Agreement which supplements the provisions of the Convention with regard to direct notification and advance communication of technical information. The Agreement applies to facilities and activities as defined by the Convention. (NEA).

9905 Civilian Defense

24047 **(SAND—87-2689C) PC/AT based network system for emergency planning and information management and display.** Desonier, L.M. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 3p. (CONF-880455—1). NTIS, PC A02. Order Number DE88004018/JAW.

From Conference of the Society of Computer Simulation; Orlando, FL, USA (18 Apr 1988).

In a time of crisis or in an emergency a manager is required to make many decisions to facilitate the proper solution and conclusion to the emergency or crisis. In order to make these decisions the manager must have correct up-to-date information on the situation. To provide this information the most logical solution appears to be an automated information entry and display process. Information handling needs can be identified in terms of data, video, and voice. Studies of existing Emergency Operations Centers and evaluations of hardware and software have been completed. The result of these studies and investigations is the design and implementation of an automated Emergency Management Information System. Not only is the system useful for Emergency Management but for any information management requirement. 3 refs., 5 figs.